University of Alberta

Targeting Productivity Improvements

by:

Barry McIntyre ©

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37 Dawson Drive
Sherwood Park, Alberta
T8H 1T7

Jan 16, 1997

University of Alberta

Faculty of Graduate Study and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled Targeting Productivity Improvements submitted by Barry E. McIntyre in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Dr. John Whittaker

Michael Long
Dr. Michael J. Long

Roger W Toogood
Dr. R.W. Toogood

Jim Whiting
Dr. J. Whiting

JC Sprague
Dr. J.C. Sprague

B M Patchett
Dr. B. Patchett

23 Dec 1996
Date

ABSTRACT

Crises, in terms of time and financial pressures are occurring with increased frequency. Traditional crisis management methods tend to be reactionary, ad hoc and narrowly focused on short term cost reduction without establishing where best to start or allowing for interactive effects of change. This research provides a systematic method for developing productivity improvement targets which address crises while providing for the long term view. Theoretical development builds on the work of Goldratt, Ackoff and Nadler, and incorporates aspects of product design.

The systematic approach developed provides a means to prioritize sub-systems for analysis and change, while considering the context of the crisis. Key to the research is the thesis that where to start is critical. Constraints the nature of the changes are reduced, providing for more creative options in dealing with crises.

It was also determined that in crisis situations, success is often contingent on the willingness and ability of management to take charge and develop feasible alternatives.

Two case studies were successfully completed to illustrate the effectiveness of the process which was developed in the research.

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CHAPTER 1: INTRODUCTION

1.1 Topic

Targeting Productivity Improvements in Organizations Facing Crisis With Particular Reference to the Alberta Health Care System.

> ***"Successful problem solvers use a target solution as an effective guide in developing details of what others call breakthroughs."*** - Gerald Nadler (1990b).

1.2 Purpose

The purpose of this thesis is to clarify which individuals within an organization should set the targets for major system productivity improvements, and to provide both a theoretical basis and a process for establishing technically feasible targets which can provide a firm with a lasting solution to an immediate crisis. The targeting process can be used as an alternative within Ackoff's interactive planning cycle (1981) to provide a default position for use in his "corporate democracy" where management is required to bring an alternative position to the table.

The process is to be used as a management tool in crisis situations where the "facts of life" (Deming, 1980) require significant, lasting improvements in performance within a short time frame. The targeting process prescribed allows existing organizations to identify major system changes and then focus on the process improvements that will accomplish the change. The resulting target is a technically feasible solution to a pressing financial threat. It is a starting point in developing alternatives for system redesign.

While the process is designed to work in a crisis situation, it may be applied more broadly. It can also be used generally where management feels it appropriate to develop potential system design changes as a basis for comparison of alternatives.

The major users will be small and medium sized businesses which are less able, in terms of time and resources, to find and retain appropriate consulting services often utilized by large firms. "Medium" in this context refers to firms and organizations to the 5000 employee range.

"Targeting" as used herein means developing an alternative prospective system (target) that can meet specified productivity requirements and time constraints.

"Crisis" means a combination of financial threat and time pressure.

"Quick fix" is a jargon term used to describe short term solutions to problems. A quick fix may not last, may prove to be incremental and may have negative long run effects. These types of fixes are usually characterized by things such as across-the-board budget cuts or staff reductions which strive for short term marginal reductions in process costs.

1.3 Background of the Problem

The literature suggests that "crisis" conditions are becoming the norm, with the rapid economic changes forcing ever increasing productivity improvements (Hammer, 1993; Whitney, 1987).

The Current Need for a Targeting Process

Year	Business Bankruptcies	% Change
1987	991	
1988	967	-2.4
1989	979	1.2
1990	1123	14.7
1991	1304	16.1
1992	1435	10.1
1993	1445	.7
1994	1592	10.2

Table 1.1: Alberta Business Bankruptcies[1]

The current economic climate has forced industry to dramatically revamp in many sectors. There has been a major restructuring and a major shift of manufacturing out of Canada[2]. The lingering slowness in the economy in the 90's is forcing many firms to make dramatic and significant changes both to their organizations and to the operating processes used. Many firms are not able to adapt fast enough, and go out of business. Table 1.1 shows the recent trends in business bankruptcies in Alberta, as an example of the problem.

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[1] Provided by Statistics Canada on request.

There is currently a need for new methods to assist firms in addressing crises. The context for "crisis" is set forth by Ford (1981) who defines a crisis as a combination of a threat and time pressure. Here, the term "threat" refers to financial pressures on a business or organization. Ford also states that crises are frequent, as evidenced by management by exception, and that these crises have two sources: occurrence of unpredictable events, or failure of the organization itself. For the purpose of this research, an additional constraint will be applied. That is, crises engendered by catastrophes such as explosions, earthquakes and other disasters will not be considered.

The following information provides some indication of a need for methods to address financial crisis in organizations:

- Of the 500 new stocks issued on the New York Stock Exchange in 1961-62, 12% vanished, 41% went bankrupt, 25% were operating at a loss in 1983, 20% were still profitable in 1983 and only 2.4% were considered worthwhile holdings in 1983. (Dunn and Bradstreet, 1983)
- Bankruptcies in Canada and Alberta set new records from 1991 to 1994.
- The Canada-U.S. Free Trade Agreement and the North American Free Trade Agreement are altering the business environment, creating a potential threat to companies traditionally protected by tariffs.

The anecdotal information above warranted a more in-depth study to find research related to the existence of crises conditions and what may have been developed for the prevention or solution of crises. Clues were sought in the literature as to whether there is a need for methods for addressing crises.

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[2] Economic Development Edmonton, March 1995.

The Urgent Need for Productivity Changes

There is evidence to suggest that there is and has been pressure on organizations to dramatically improve performance in short periods of time and that there is a need for improved methods.

Published research indicates that there is a need for effective methods of producing productive changes in organizations. Beer (1990), in a study of six companies, looked at the difficulty of actually producing change in an organization, in an article titled "Why Change Programs Don't Produce Change."

Reach (1991) discusses the need for productive change in the service industry. Enormous job losses in the service sector and the low productivity of white collar workers are reported in his work. It is also suggested that service companies need to respond quickly to adapt to sudden threats such as from foreign investment. One additional finding of Reach is that the service sector was subjected to a technology overdose which has not generated the desired improvements in productivity. Increasing introduction and use of technology has resulted in increased costs without corresponding increases in productivity.

Stalk (1989), in the context of competition in the product development field, suggests that time is the next competitive advantage, and that firms who are slow may suffer. This is directly related to internal productivity, and the need to be more productive in providing goods and services. "Productivity" improvements in the area of product development means getting products out the door faster. Cooper (1989) has indicated that the ability to successfully develop and introduce new products may be the key to survival.

Progress in Addressing Productivity Issues

There is room for significant progress in addressing productivity related concerns. Laliburty (1984) comments on the need for new methods to address productivity related issues:

- Management ineffectiveness is the single greatest cause of declining productivity.
- Most efforts to improve productivity are misdirected and uncoordinated.
- The scope of most productivity improvement efforts is too narrow, focusing on costs rather than system effects.
- Most efforts are geared toward "quick fixes" rather than long term solutions[3].

Whitney (1987) suggests that turnaround opportunities exist everywhere, and are no longer special cases, but a familiar part of business life. His research also indicates that structural change is required, and that most turnaround leaders change processes without changing structures.

Thietart (1988) discussed the effectiveness of strategies on improving poor performance, and concluded that success depended on the firm's objectives. The study focused on product firms, rather than service firms. The study also concludes that there is, as yet, no particular strategy for turning a firm around.

Schaffer (1992) has proposed a broad strategy for effecting major productivity improvements in short periods of time. This strategy has application to the types of crises considered in this thesis. His work also indicates that short term solutions or fixes may also be long term improvements. Schaffer identifies as one component of his strategy the need to determine performance targets and timelines for meeting these targets. He does not outline a specific methodology for "targeting" but states that targets must be set.

Crisis management literature is primarily internally focused, looking to immediate cost and cash flow improvements. This differs from management literature which has an external, customer focus. Total Quality Management systems (Juran, 1988; Deming, 1980) have a strong external focus. The successful concepts of Nadler (1990) and Ackoff (1981) look at the whole organization and its interactions both internal and external, and also differ from crisis management methods.

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[3] "Quick Fix" is a negative connotation used to describe changes which may be in conflict with long range goals and objectives.

Operations management literature is expanding to deal with interactive effects within and between the various components and people in organizations while crisis management literature is primarily focused on cost reduction and containment. In dealing with crises, the complex interactions of the organization tend to be ignored. As Whitney pointed out, the crisis approaches are "quick fix" focused. The customer tends to get forgotten until the crisis has passed.

The research shows a need for methods to assist managers in generating significant, lasting productivity improvements in order to survive. In this context, an important component is that of targeting where these improvements can and should be made, as well as addressing the issue of who should make the determination.

1.4 Methodology

The research methodology was developed using the Case Study Research methods of Yin (1994).

Research Strategy

The research strategy is to combine a linear analytical approach with case study research methods to develop theory and propositions, and then test them with case studies. This approach is applicable because the research deals with a contemporary set of events over which the investigator has little or no direct control (Yin, 1994, pp8-9).

As applied in this research, the case study approach helps to inform general theory and explain conditions that deviate from traditional explanations (Bradshaw, 1991). The characteristic of illuminating phenomena that challenge established consensus is important in the use of case studies for contemporary issues, as there is not the ability to gather large samples for analysis. Bradshaw also suggests that in addition to informing general theory, the case study approach may be useful to establish partial validity of theories or propositions, or point to nuances of theories. With contemporary issues, full validation of a more general theory may not be possible, but partial validation is still a contribution, according to Bradshaw. He also suggests that the case study may be used to generate new beginnings or new branches of theory in a particular area.

There are some aspects of participatory action research in that the case studies are interventionist in nature rather than observational (Frideres, 1992). Organizations participating did not participate in the design of the targeting process, however. They only participated to varying degrees in the application of the design.

Research Design

The research design presents the questions, develops the theory and propositions, describes organizations in crisis as the units of analysis, develops the logic linking the data to the propositions and establishes the criteria for interpreting the findings. The design for this research is holistic. This includes the overall system including theoretical propositions, followed by case studies to test the theoretical developments. This is consistent with the Case Study Research methods of Yin.

Theory building is a critical component in this research design. A complete research design embodies a theoretical basis to be tested. The theory building portion of the research design provides the blueprint for the propositions to be tested in the case studies. The theory development was concurrent with the exploratory case which was used as a preliminary test of the propositions and to develop the protocol for conducting subsequent cases. Theory development in Chapter 4 provides development, in logical order, of the theoretical base, the targeting process and the application protocol.

The subsequent case studies were then conducted and used to generalize and validate the theory. The studies are checked to see if they support the theory but not rival theories. Analytical generalization is used. After developing the theory, the empirical results are compared to those predicted by the theory.

The criteria for judging the quality of design are:

1. Construct Validity. The theoretical basis for targeting was put in the form of a staged process. Operational measures, in the form of a protocol were developed to apply this process in case studies. Evidence was gathered for the targeting process from an exploratory application to a hospital system, a radiology department and a drilling fluids firm. Comments and results from key

representatives of these application areas were documented to confirm the results.

2. Internal Validity. The results of the case studies are compared to the theoretical propositions developed in the theory building phase. Validity is established when the results match those predicted by the propositions and theory. Results of the three applications are analyzed to determine the level of explanation of the developed propositions and theory.
3. External Validity. External validation is based on replication. If the approach can be replicated, the approach is validated. Case study results from the two applications are compared for consistency based on the underlying propositions. Differences in results between the applications are analyzed to determine whether they are predictable from the propositions. Theoretical replication is achieved when there are different results for predictable reasons. Literal replication is achieved when there are similar results from different cases.
4. Reliability. A case study protocol is established to specify who does what and under what conditions. Procedures are documented. In the applications, the protocol is refined with additional applications.

Analytical Strategy

The preferred strategy (Yin, 1994) is to rely on theoretical propositions. The dominant mode of analysis is pattern matching. This compares the empirically based pattern with the theoretically predicted one. The key is to determine whether predicted results are found and that alternative patterns predicted by other theories are not found.

The explanation building portion of the analysis shows the causal links and build an explanation of the case results. This includes comparison with the results expected using rival methods.

Research Method

The research method has the following steps:

1. Problem statement.
2. Literature review to establish what has been done to date, and where logical next steps may be taken.

3. Logical development of the theoretical basis and process for the suggested direction.
4. Development from the exploratory case.
5. Selection of additional cases to be studied.
6. Conduct the case studies.
7. Report on the individual cases.
8. Develop cross case reports and final analysis.

Selection of Applications

There were two applications of the targeting process. One was in the area of health care while the second in an unrelated industry. This additional case was selected due to significant changes which prevented further application in health care: the organizations were eliminated and/or changed, and many of the personnel involved were removed or replaced. The second area, a drilling fluid company, was a new company in a highly price competitive industry. Economic conditions forced a quick resolution of productivity issues in order for the firm to survive and grow.

Nursing Care

Nursing care at the University of Alberta Hospitals was used for exploratory research in developing the targeting process. This was based on existing relationships with the University of Alberta Hospitals' Quality Assurance staff and previous research conducted for other departments within the hospital.

A product development project to develop a point of care terminal for use by nurses to improve productivity in data collection provided the initial information and insights which led to the decision to use this area for exploratory research in order to develop the process to be applied in the subsequent cases.

Basic research began with the Research and Technology Department in 1988, with subsequent research in 1989 and 1990. This research provided the basis for much of the exploratory application. A good working relationship was developed with Mr. Joe Altopedi who was in charge of Quality Assurance (QA) and was implementing a TQM system. The product development research partner was Mr. Taras Diduck, who was later given a position in the QA department.

This relationship provided ready access to very basic information required for trial purposes, and feedback as to how the process might be improved for full scale application. In June 1990, the Management Team was given a presentation requesting a full application. Limited support was given by management and the project was referred back to the QA Department. This stage of the project was useful in that it provided insights into some of the issues raised in the targeting process regarding management involvement and commitment.

The basis was in place for the exploratory research which led to the development of the critical elements of the targeting process. The product development work provided some operating information and problem areas, but more detailed research into health care operations was conducted in late 1992 and early 1993.

By this point in time, there was no further support from the hospital for this research. Dramatic externally imposed changes in the organization completely changed the structure, key members of the QA staff, including our primary contacts, were released, and all continuity was lost.

Radiology

The Radiology application began one year after the nursing care exploratory application. This application saw implementation of suggested changes and provided more refinement of the process. Mr. Bill Steinberg of the Misericordia Hospital provided strong support for the project. Initial meeting took place in late 1989, with the process continuing until 1991.

There was strong support from the radiology management for this research. This contrast will be expanded on in the case study analysis.

Drilling Fluids

This application provided an interesting contrast to the health care applications. The project was started in late 1995, with initial results realized in mid 1996. This application was developed because the dramatic changes in health care industry effectively cut off data and study. The health care organizations and contact personnel have all been changed or replaced, causing a complete loss of continuity. An October 27, 1995 communication from Dr. Jane Fulton, Deputy minister of Health for Alberta, indicated that they were too busy trying to reduce health costs to assist in testing a method which identified more productive alternatives.

In contrast, this application had the willing support of management to develop and implement system changes. The firm desired to apply the process in order to identify potential for significant improvements. The drilling industry in western Canada is well developed, with a focus on further exploration of established fields, workovers and enhanced recovery methods. These currently tend to be cost driven. A new firm must be able to provide very cost effective service, with a lot of pressure on margins.

Mr. Reg Northcott, President of Q'Max Solutions Inc., of Calgary wanted to apply the process to rapidly identify alternatives. This strong support of the application insured quick implementation of the improvements developed. The nature of the "crisis" in this case was that the firm recently started operations in a service area which is almost 100% price competitive. A productivity edge had to be developed quickly to insure survival and growth of the firm.

1.5 Contribution

There are three areas where this research extends knowledge.

1. Application of TQM/product design methods to target productivity improvements in the service sector.

Matrix methods are adapted for use in prioritizing organizational sub-systems for analysis and redesign. Quality Function Deployment (QFD) methods, specifically the "House of Quality" or HOQ matrices are utilized to maintain a direct linkage to the customer generated revenue stream in order to achieve prioritization.

The rules for prioritizing of the sub-systems are based on principles developed by Goldratt (1980). Priorities are based on the effects on net revenues. The HOQ matrices maintain an orderly representation of the relationships between the organization and the customer, while showing the interactive effects of various components. The development of system changes uses novel application of Activity Based Costing (ABC) concepts to approximate relative costs without detail data.

2. Extension of the work of Ackoff/Nadler to time-constrained situations.

Both Nadler and Ackoff have successful system design processes for generating productivity improvements. These processes are for use where time constraints are not binding. The targeting process developed in this research shortens the front end process of identifying a target for system design changes.

The targeting procedure is also consistent with the approaches of both Nadler and Ackoff in that it is systematic. In keeping with Ackoff's interactive planning cycle, the targeting process provides a "default" position which can either be implemented or used as a benchmark for alternatives. Use of the targeting process can thus be used to enable constrained empowerment in cases where it may otherwise not work.

3. A practical tool to be used by decision makers (senior management) in crisis situations.

Targeting as developed in the thesis provides a practical tool for senior management use. By applying the targeting process, senior management is in a position to determine first whether there are alternatives with which to address a crisis, and then to have a potential course of action.

The tool focuses efforts on where to look for potential changes, with little constraints on how to develop changes. Existing crisis techniques focus mainly on constraining costs, with little focus as to where to start.

CHAPTER 2: BACKGROUND

2.1 Introduction

The literature indicates a potential need for means to address crises in organizations. A survey was conducted to examine what has been done to deal with this problem and to find evidence of directions that research may head in dealing with organizations facing crisis.

Sections 2.2 and 2.3 deal with literature directly addressing crises. The first discusses the topic from the overall perspective, while the second deals with techniques that can be applied in a particular organization.

There are several areas of industrial process research which touch on many of the issues involved in crises situations and for generating productivity improvements. These concepts are generally in the context of being used to avoid a crisis rather than resolve one. They do provide some of the tools, components and background used and integrated into the thesis. Sections 2.4, 2.5 and 2.6 discuss these concepts.

Section 2.6 discusses the current crisis situation in health care in Alberta to provide background to the application in that area. Section 2.7 summarizes where the research points in terms of potential advancements.

2.2 Overview of Approaches to Crises

Papers which relate to approaches to addressing crises fall into the following areas: organizational decline, management response time, downsizing, job redesign, and crisis management. One book and two articles by Schaffer (1974; 1988; 1992) addressed the issue of significant productivity improvements, and suggested that they may be achievable in a short period of time, and may be sustainable.

Organizational Decline

Boyle (1991) conducted a literature search and outlined 24 factors which are apparent causes of failure of a firm. This research does not suggest any process which a firm may use to redesign their operating system to effect a turnaround.

Ford (1981) differentiated crises into catastrophic and organizational failure. He also found that failure to identify variable relationships, "groupthink", distortion of information and misplaced optimism were sources of failure. The common responses were denial and contraction of authority. Suggested methods of coping: increased planning, improve understanding of internal dynamics, modify dysfunctional decision making and reduce information distortion. These methods of coping incorporate some aspects of system thinking (Senge, 1990).

Management Response Time

Ellis (1982) identified management response time as an important factor in a firm's ability to face uncertain and rapidly changing challenges. He concluded that management should face challenges practically, actively, flexibly and sensitively. He stressed that management should look for good, useable solutions rather than ideal solutions. It was also suggested that there is often a need to develop solutions outside conventional or known experiences and ways of thinking. Mooney (1990) discussed quick response management as a means of preventative medicine, to be used in treating problems at their earliest stages of detection. It is also suggested that it can be used to restore "sick" firms. Faster problem identification and solution is the main challenge of this approach, however. A process was not suggested to achieve faster problem identification and solution. Quick response management as suggested in the article is not in the system context, but appears to deal with problems symptomatically. He states that problems and opportunities are the same, and that problem signals are in terms of "customer driven measures," customers being external purchasers of products.

Downsizing

Tourangeau (1987) presents downsizing as a means to achieve structural improvements resulting in improved productivity. The suggested methodology is to set targets, gather information, recommend changes, have senior management modify recommendations and implement the changes. The data and measures do not require a high degree of accuracy in this approach. Simple measures can yield deeper insights, according to Tourangeau. He deals with reductions of employees, but not changes which could potentially increase both productivity and employment. Some systemic problems are addressed, but only the more obvious non-productive areas.

Imberman (1989) suggested a three step process for downsizing to achieve cost reduction. The steps are: define problems, determine what should be done and increase skills. Problem solving skills are important. There is no definitive process suggested for carrying out these steps.

Job Redesign

Job redesign as a means of enhancing productivity does not have an impressive record (Kopelman, 1985). Many of these efforts have focused on factors such as "job enrichment" rather than the older industrial engineering methods of determining job requirements and matching personnel to the tasks required. Kopelman suggests that the older approach troubles workers. One question unanswered in his work is what to do if the tasks required do not correlate well with the workers in the organization. Job enrichment may not work when the workers are overqualified or improperly qualified for the required tasks. The 32 experiments in job redesign, while showing an average of 6.4% improvement in productivity, showed also that productivity was not reliably increased. There was evidence that gains were not long lasting. Another factor in Kopelman's work is that there was no determination as to whether the jobs or tasks requested of workers were correct.

Hammer (1990) suggests that operating processes should be redesigned to "obliterate" work. This indicates a system wide approach to re-engineering the firm is required, with a view to eliminate needless work. Hammer's approach is process focused, with changes determined on a process by process basis. Davenport (1990) supports this idea. He also supports the idea from a system perspective, to some degree by suggesting that the redesign process should begin by developing a business vision, process objectives and then identifying areas for redesign. However, this stops short of a full redesign of the whole system. The focus is on processes, rather than the whole organization.

Whitney (1987) offered some general suggestions of the need for structural change to address crises, and comments on the need to evaluate whether processes used are necessary. In his research, Whitney does not connect the needs of the customer to the processes being considered, and does not offer concrete "how to's."

Crisis Management

Mitroff (1988) suggested that crisis management is generic, with five phases: detection, preparation/prevention, containment, recover, learn. The type of crisis addressed is external, catastrophic crisis. Internal organizational crises are not addressed in his work. Slater (1984), in studying management response to crisis, found that denial was a major factor as crises built over time. Crises are not noticed right away, and are allowed to grow unnoticed.

Schaffer (1974) indicates that improvements are obtainable and maintainable. He suggests that a process of selecting goals, specifying results, communicating expectations, monitoring projects and extending the process will achieve good results. This process does not provide technical details as to how to conduct these activities, nor does the approach necessarily address system wide problems.

2.3 Specific Techniques for Use in Crises

Cost Accounting Approach

Cost accounting is used to measure operating costs. Cost reduction goals are derived from macro considerations such as a 20% budget cut and are arbitrarily set for each area or sub-system. There may be some adjustment for obvious priorities such as feedstock in a chemical plant - it may not be possible to cut items such as this, or at least not by the desired amount. This results in deeper cutting elsewhere. The process of cutting results in direct reduction of operations. The effect would be a reduction of services and staff.

The main benefit of this approach is that the reductions could be implemented very quickly.

Industrial Engineering Work Study Approach

A conventional IE approach could be applied to target productivity improvements (Mundel, 1994). The IE approach is to select a product or process, flow chart the process and perform critical analysis. All the steps of the process would be put in a detailed flow chart. The critical analysis would focus on the "do" activities. The critical examination procedure seeks first to eliminate or reduce the number of "do" operations. Generally ways would be found to reduce direct costs. This would not change overheads.

The approach is process focused and would provide either increased output or lower costs for the same outputs for the particular process being analyzed.

Re-Engineering

Re-engineering is used to generate major system breakthroughs or improvements. References for the methods are provided by Hammer (Re-engineering the Corporation, Harper, 1993). Re-engineering is process focused, and seeks to redesign all processes. Re-engineering has a prioritization scheme which is based on:

- Obvious problem areas. Hammer suggests that these are areas which everyone in the organization knows are not working properly. He also states that these would include those processes with a lot of waste, scrap and rework.
- Important processes. These are processes which directly affect the customers outside the organization and relate directly to product quality and cost issues.
- Feasibility. This includes process changes which have a short payback period for the costs incurred in making process changes.

The approach strives to increase the multidisciplinary nature of work and reduce expense by reducing layers and the need for management. The re-engineering effort uses teams for all processes being studied.

Total Quality Management

One major area of current research to address productivity is Total Quality Management (TQM). This method, an attempt to emulate successful Japanese practices, is a customer focused philosophy rather than method per se. The goal is to meet the needs of the final, external, customer, as well as the needs of "internal" customers. An internal customer is the person who receives work, services or parts from another in an organization. This field of management has several tools and components of interest. It also has some drawbacks for rapid improvements.

The major drawback in the TQM context is time. TQM discourages "quick fixes" in favour of long term gradual change. Juran (1988) indicates that large numbers of improvement projects, taking several years (usually five or more), are required to achieve significant, measurable improvements. These conclusions are typical of published material on the implementation of TQM and the performance of TQM systems. The problem is that organizations in crisis do not have the time.

TQM's effectiveness in improving a firm's competitiveness is still in question. The Ernst & Young report (1992) portrays TQM largely as a failure. Local TQM expert Bill Doak, who has developed the majority of the training material used by Dow Chemical Co. suggests that 80% of TQM implementations fail due to lack of alignment of purposes within the organization. Total Quality Management thus is not really a method to use in a crisis. It is supposed to prevent crises from occurring. Like re-engineering, TQM would be disruptive and time consuming.

A lot of time is required due to the means of introduction. The first step is to establish and train teams representing the different processes in the organization. The teams will be given a TQM tool kit and methodology to develop improvements. The focus of the improvements will be reduce waste/rework, reduce variance and reduce non-value added time for a given output level.

The teams will then begin gathering data on all the processes in the organization and charting them. This will be required to determine the cause of losses. All processes will have the same priority, as "quality is everyone's responsibility."

Practices such as team building, empowerment and self managed teams, in vogue with implementations of TQM, will only be effective when:

- The organization develops a vision.
- This vision becomes shared and alignment develops in the organization. Empowerment without alignment is similar to all the lights at an intersection turning green at once. Everyone is "empowered" to go, and serious problems arise. These problems reduce commitment and effort and work to kill the implementation.

Further, since the crisis would probably result in lay offs, it could be difficult or impossible to maintain the trust-culture essential for TQM implementation.

In contrast, major tools used in TQM applications are useful in dealing with specific problems or issues. Standard TQM tools such as cause and effect charts, Pareto charts and histograms can be applied in the design of more effective organizational systems. Quality Function Deployment (QFD) (Hauser, 1988; American Supplier Institute, 1987) is a matrix method which ties product specifications and production processes to the customer. The method shows interactions and complex relationships between all the relevant resources and sub-systems which provide input to production. The integrity of the customer linkage is maintained.

QFD has similar characteristics to, and is compatible with both concurrent engineering and the stage gate systems used in product development. The matrix charts connect the customer and all processes in meeting the customer's needs, including design specifications and production processes. Beginning with the customer, certain information has to be identified correctly before subsequent activities can take place.

Critical process research began in 1992 and continues at GOAL/QPC to develop measures which can be used for targeting high leverage opportunities for improvement. Some useful research related to production costs and productivity has been done by Goldratt (1984). This work provides a conceptual framework for costing based on utilization of resources. "Bottleneck" resources which limit throughput have high marginal costs, as they directly impact output and thus revenues, while resources/processes which have idle time or slack, have very low marginal costs. Identification of large potential cost savings is facilitated using these concepts. Goldratt's work also indicates that costing on a total cost per unit basis may have some advantages.

Pareto Analysis

Pareto analysis is not a tool for developing alternatives, but is used as a means of prioritizing (Montgomery, 1991). Pareto analysis is a method of prioritizing based on relative magnitudes.

It may or may not be sensitive to the measure used. For example, using an output measure may give a different prioritization than using dollar costs.

Competitive Analysis

Choosing which services to out-source is a form of prioritization. Competitive analysis can be used to determine whether privatizing or contracting out will reduce costs. The competitive analysis is based on amortized rate of return, with comparison based on providing existing levels of services (Sprague, 1986).

Each area would be evaluated at its existing service levels against the cost of contracting or out-sourcing. Contracting out would fix the relative service levels at existing throughput rates. This analysis provides for deciding between alternatives when a process or resource group has been selected for analysis.

2.4. The Organization as a "System"

Senge (1990), like Nadler and Ackoff, has described the organization as a system. In this context, incremental organizational change is difficult. Organizational relationships have an inertia about them, and symptomatic behaviour tends to force processes back to where they started. There are key characteristics to consider in identification of where an organization is, before adopting a strategy for change. There are also other characteristics, such as commitment to truth, which are required to make an honest assessment as to what should be done. It was in this context that Steven Covey, author of "The 7 Habits of Highly Effective People" and "Principle Centred Leadership" commented that first, you have to do the right things, then you do things right.

Ackoff (1980) provides a system framework for productivity and profitability improvements. Russell Ackoff's highly successful career is a testimony to the power of his ideas. He is currently Chairman and CEO of INTERACT: The Institute for Interactive Management (Philadelphia) and the Anheuser-Busch Professor Emeritus of Management Science in the Wharton School of the University of Pennsylvania. He is a past president of the Institute of Industrial Engineers and has successfully completed several large scale consulting projects using his concepts.

In his book *Creating the Corporate Future*, Russell Ackoff (1981) provides the following key concepts:

- The concept of breaking the organization into profit centres which interact.
- Interactive Planning, a broad approach to change which requires targeting.
- Planning within various systems in an organization is not an independent process, interactions cause other effects.

Interactive planning is a planning procedure which allows for the interactions and system effects within an organization. Ackoff proposes a 5 phase procedure:

1. Formulate the mess into a system of threats and opportunities.
2. Ends planning - specifying desired results.
3. Means planning - selecting means to achieve results.
4. Resource planning - resource requirements; how to obtain them.
5. Design of implementation and control.

The interactive planning cycle requires the development of feasible targets, but methodology by which targets are developed is not stated. Figure 2.1 shows a representation of Ackoff's planning cycle.

In viewing the organization, Ackoff stresses knowing the differences between claimed and actual organizational structure and processes. When examining potential structural changes, this becomes a concern primarily for implementation. It may also cause concerns when determining cost factors. In beginning the planning cycle, Ackoff looks at the gap between where the organization is and where it would like to be. The primary difference between this idea and the focal point of this research is that the targeting procedure focuses on where the organization has to be. There is a fundamental difference in philosophy as it relates to urgency.

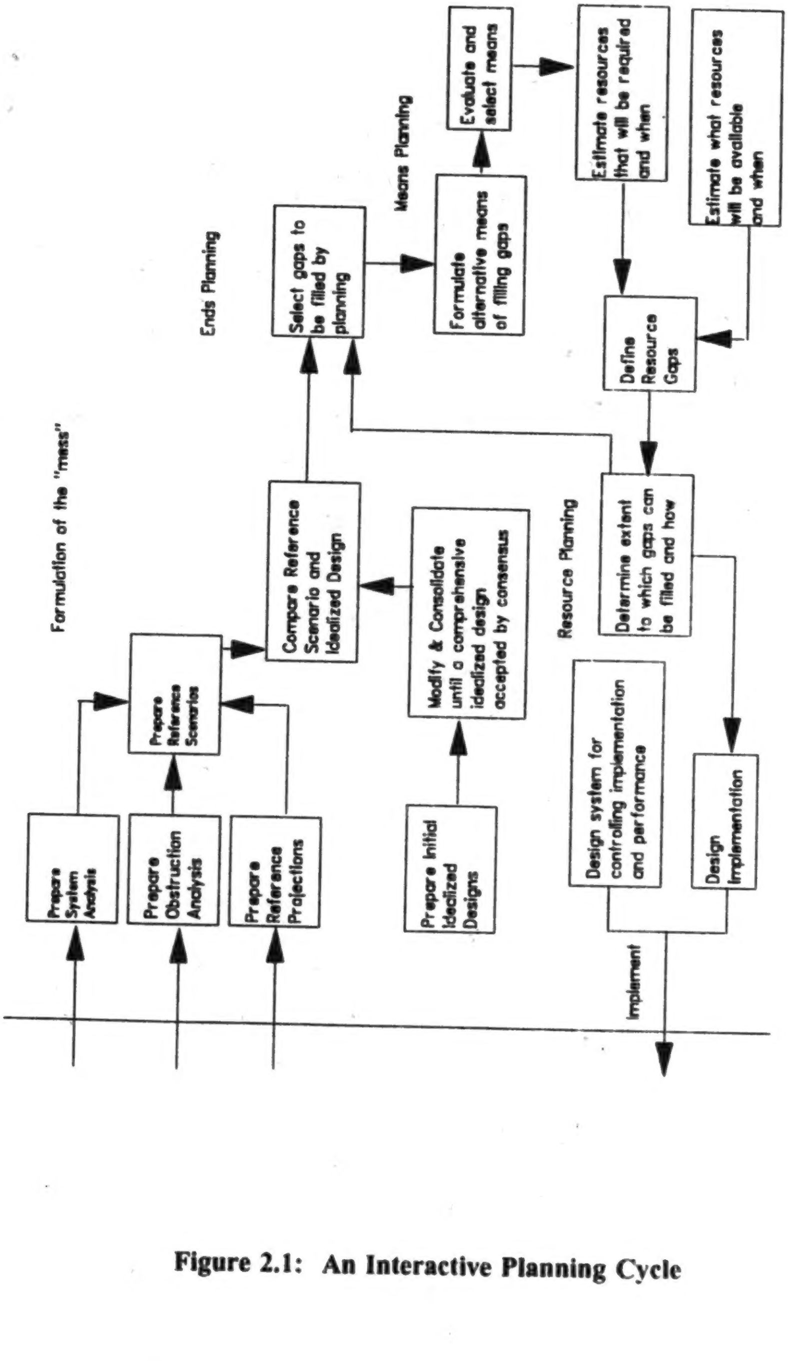
Formulation of the "mess"
Ends Planning
Means Planning
Resource Planning
Implement
Prepare System Analysis
Prepare Obstruction Analysis
Prepare Reference Projections
Prepare Reference Scenarios
Compare Reference Scenario and Idealized Design
Prepare Initial Idealized Designs
Modify & Consolidate until a comprehensive idealized design accepted by consensus
Select gaps to be filled by planning
Formulate alternative means of filling gaps
Evaluate and select means
Estimate resources that will be required and when
Estimate what resources will be available and when
Define Resource Gaps
Determine extent to which gaps can be filled and how
Design system for controlling implementation and performance
Design implementation

Figure 2.1: An Interactive Planning Cycle

Gerald Nadler is currently professor and chairman of Industrial and Systems Engineering and holds the IBM Chair in Engineering Management at the University of Southern California. Dr. Nadler is also a former president of the Institute of Industrial Engineers and has an extensive research and publishing record. He has also successfully applied his work in several public and private organizations.

Nadler's idea is to generate "breakthroughs" which are significant improvements to the system rather than incremental improvements. He stresses a "clean sheet of paper" approach which seeks to avoid preconceptions as to potential solutions to problems. The solution ideas are to achieve both the selected and bigger purposes.

The Planning and Development Approach of Nadler (1990) is purpose driven. This is adaptable to the targeting process which is focused on generating potential improvements in a time constrained setting. The focus on purposes helps strip away the non-essential aspects to avoid working on the wrong problems. The system context is retained in that we are reminded that every problem is part of a larger system, and understanding the system is important for implementation of solutions. Nadler also stresses that successful problem solvers use a target solution as an effective guide in developing details of what others consider "breakthroughs."

In discussing problem solving, he also points out that it is wise to use a synthesis of approaches. Integration and synthesis lead to breakthroughs. In order to begin, it is first required to determine the gap to be closed. This is considered the key step. This relates directly to purpose and required outcomes, essential in dealing with firms in a crisis position or facing severe constraints.

A second key concept presented by Nadler is the limited information concept. Problem solvers should focus on not collecting large amounts of data. Data should not be collected until you have very specifically identified the purpose, otherwise you will gather needless data and will have to revisit the data sources to obtain the correct data.

He also states that knowing too much about a problem initially can prevent you from seeing some excellent alternatives. Preconceptions can become blinders, so do not become an expert about the problem. This also supports management in dealing with targets, as management often does not know details of operations, but does know what results are required.

To maximize use of time, effort and resources, Nadler suggests that only the necessary information should be collected. An excess of operating data does not necessarily generate useful benefits. As Nadler points out, information is only a representation, the future cannot be predicted from even perfect information and collecting of information is not neutral. Relevance rather than accuracy is important. This is especially of note for targeting productivity improvements in time of crisis.

Nadler's Planning and Design Approach has the following steps:

1 Develop a hierarchy of purpose statements.
2 Generate solution ideas which achieve selected and bigger purposes.
3 Group and shape ideas into major alternatives from which a target will be selected.
4 Detail the solution recommended.
5 Install the solution.

The approach is not specifically designed for use in crisis situations, but has some features and characteristics which may be useful in addressing crises.

2.5 Goldratt and ABC Costing

ABC costing and the production costing methods of Goldratt (1986) provide a basis for establishing total production costs per unit of production.

ABC is a recently developed method for assigning overhead costs based on the activity time consumed by those in an overhead function such as administration or marketing.

The driving concept of Goldratt's system of analysis is the "Goal" of the organization, which, in his example, is to make money (Goldratt, 1986). Expanding to non-profit and government operations, the concept would also mean more efficient, lower cost of providing outputs. The measures given for "making money" are profit, return on investment and cash flow. All are important to success of a for-profit organization. For example, it is possible to go bankrupt while showing a profit.

Accrual accounting can show a profit while a firm can run out of cash. It is also possible for a firm to have positive cash flow and not be profitable. Thus, the "goal" requires all three measures. In this environment, the contribution to the "goal" becomes the highest priority.

The goal is always the same, but there may be different ways of expressing it.

These concepts have been recognized as having merit by several authors. Jacobs (1983) acknowledged that Optimized Production Technology (OPT), which is based on the concepts of Goldratt, has made a significant contribution to the state of the art in production scheduling. The procedure only considers "critical" (ie bottleneck) resources. Lundrigan (1986) observed that the methods of Goldratt would be very useful as a start up tool and for estimating requirements for production processes. Lundrigan goes on to say that the methods are used by Ford, GE, Westinghouse, RCA, Bendix and Avco.

Melton (1986), Plenert (1986), Swan (1986) and Vollmann (1986) also agree with the previous authors that these methods have merit. They support the feasibility of the logic for the process proposed by Goldratt. They also support the concept that gains are possible by utilizing the philosophy of the optimization process without using Goldratt's proprietary software. This provides a basis of support for incorporating portions of the philosophy of Goldratt in the targeting process.

As Goldratt related, the "goal" of the firm is to make money. At the operations level, the goal is expressed with the following measures:

- Throughput
- Inventories
- Operational Expense

These can also be described as money coming into the system, money in the system and money leaving the system. Throughput is defined as the rate at which the system generates money through sales. It is not just a production measure. Inventory is all the money the organization has invested in purchasing things which it intends to sell. Operational expense is all the money the system spends in order to turn inventory into throughput.

Within the throughput based analysis, the measures of throughput, inventories and operating expenses cover everything. The view is holistic rather than focusing on local optimums as conventional cost accounting does.

Stated in terms of these three measures the goal is to increase throughput while reducing inventories and expense. This results in a lower average total cost per unit throughput (McIntyre, 1992), a measure which may be usefully applied to publicly administered organizations.

Productivity improvements are activities that move towards making more money. Activities that do not result in making more money are not productive. The focus is on activities, as activities are what consume resources and generate throughput. Costing of these is compatible with ABC. To get productivity improvements, an organization must first get a clear picture of what is required to stay in business. This is a purpose driven approach in line with Nadler (1993) and Ackoff (1981).

Goldratt comments that when striving for productivity improvements, the focus should be on the total cost per unit of production rather than on incremental costs. Since return on inventories is not possible until sale, inventories are actually considered by Goldratt to be a liability, not an asset as in common practice in accounting. Since employees time is not sold, it is not inventory only expense. Inventory does include capital and equipment, as it can be sold.

In this systems context, the only way to create excess inventories is to have excess activities. This ties back to the concept that only activities consume resources. If there is an excess of inventories in the system, it could only have been created by excess activity levels. Inventory reduction should either be reflected in reduction of manpower or in increased throughputs.

Goldratt defines a bottleneck as a situation where capacity is less than or equal to the demand placed on it. Bottlenecks determine operational capacity and inventory levels. The key concept introduced by Goldratt which relates directly to costing, is that the bottleneck carries the full opportunity cost of revenue with it. Changes in flow through a bottleneck directly affect throughput and thus revenue. Bottlenecks limit the productivity of the system.

These concepts are useful in determining areas for improvement, as they provide the means to assign values to activities. The concepts do not consider costs in isolation but rather the cost effects on the whole system. In the system context, employees are not kept busy just to stay busy, but efforts are directed at improving throughput. If activities do not result in improved throughput, they generate unnecessary expenses. This is due to the notion that activities consume resources. Resources consumed but not resulting in sales are increased expense for existing sales levels, not improved efficiencies.

Activity and utilization are the terms Goldratt uses to differentiate between wasted expense and throughput generating time. Utilization is the term for activities which generate throughputs. Costs are directly tied to activities, and thus activities may be used as a measure for relative costs in some instances. For example, hourly employees direct labour cost is proportional to time spent in the workplace. If productivity is improved, and relatively less time is required for activities, changes in time requirements may be used as an approximation for changes in costs.

The focus for improvement is consistent with Ackoff (1981) in that it strives to close the current gap, rather than some projected future gap. Some considerations to use when striving for improvements:

- Balance flow with demand, not capacity.
- For any resource which is not a bottleneck, the level of activity from which the system is able to profit is not determined by its individual potential, but by some other constraint within the system.
- Utilization and activities are not the same.
- Bottlenecks govern throughput and inventories.
- Inventory is a liability.
- Look for an intrinsic order of events.

Goldratt also suggests a 5 step process for system improvements:

1. Identify system bottlenecks.
2. Decide how to eliminate the bottlenecks.

3. Subordinate everything else to the above decision.
4. Improve throughput in the system bottlenecks.
5. If, in a previous step a bottleneck has been broken, go back to step 1.

This system of analysis and determining cost effects fits with the ABC costing methods, if revenue effects are included with activity costs.

ABC seeks to address problems dealing with the application of overheads, since traditional accounting methods sometimes give misleading results (Ochs, 1991). ABC seeks to address this problem by identifying activities consumed as cost drivers. Traditional costing methods normally allocated overheads by dividing total overheads by amount of direct labour used in production. This method does not allow for different overhead inputs relative to different product lines.

These different input requirements vary with factors such as lot size, number of orders, invoicing requirements, set up times and inventory costs. For example, an order for 1000 units takes about as much time to enter as an order for one unit, yet both of these are independent of the labour requirement for production. Conventional cost accounting would spread the costs of both orders over all production based on production labour per unit. If both products required the same labour content, they would be assigned the same overhead rates. Under ABC, the larger batch would have a unit overhead rate of 1/1000 that of the single unit for the order entry operation.

ABC is thus a productivity accounting method which seeks to assign overheads based on actual activity time requirements for a particular production item. The concept invoked is that activities consume resources, so an activity list is used to determine resource consumption and thus costs for assigning overheads. This is in alignment with the profit centre concept of Ackoff, in that a representation of actual goods or services purchased is required, rather than some average over several unrelated products.

	Product A	Product B	Total
Production Volume	50	1,000	
Cost per Setup	$1,000	$1,000	
Number of Setups	1	2	
Batch Size	50	500	
Total Cost of Setups	$1,000	$2,000	$3,000
Direct Hrs. Labour per Unit	2	2	
Total Direct Labour Hrs.	100	2,000	2,100
Setup Cost per Direct Labour Hrs. ($3,000/2100)			$1.43
ABC Overhead Per Unit A = $1,000/50; B = $1,000/500	$20.00	$2.00	
Conventional Overhead Cost per Unit ($1.43 X 2 Direct Labour Hrs.)	$2.86	$2.86	

Table 2.1: Comparison of ABC and Conventional Cost Accounting Results

In using ABC, a bill of activities is created. Activities and respective times are noted for each product. This helps avoid mis-allocation of overheads and incorrect decisions regarding product lines and profitability. The following example (Tippett, 1993) illustrates on the one hand how differences in calculating work, and how the results using both methods could give signals for very different management decisions.

The bill of activities is the key to the use of ABC for the targeting application. In concept, costs associated with resources used are assigned to the appropriate customer. ABC also implies that unused resources in the overheard functions do not have to be applied to the customer.

2.6 The Crisis in Alberta Health Care

The major application chosen to demonstrate the targeting process to be suggested is the Alberta Health Care system.

The Problem

North America is currently facing a crisis in health care due to runaway costs according to Fried (1992). The issue is critical in both the United States and Canada. Health care was a major issue in the 1992 elections in the United States because of high cost and lack of universal availability. In Canada, the escalating costs of health care are regular items in news coverage by the various media. Cost containment issues were the focus of the 1991 Supplement to *Healthcare Financing Review*. In that issue, Jencks (1991) indicated that health care costs are rising at 2-3 times the rate of GNP increase. The reason given was that the cost inflation is structural, and thus built into the system. Linden (1992) supports this research by indicating that traditional market controls are not working, and that healthcare costs, currently 12% of GNP, are still rising.

Herzlinger (1989) raised the issue of need for significant productivity improvements in the health care field, showing that health care costs are rising 50% faster than the Consumer Price Index (CPI). He also indicates that the cost increases are unpredictable and cause problems for insurers. Evidence of serious quality problems was also uncovered. The failure of management to deal with these problems was the focus of her research. Drucker (1991) supports this by stating that massive increases in hospital productivity are required. He indicated that the productivity increases needed were in the form of reduced patient treatment costs as well as lower total costs for health care while maintaining or improving services.

Alberta's Health Care Crisis

The Provincial Government of Alberta, which funds health care in the province, has been holding budget increases to a rate less than inflation to reduce the real costs of care. Nancy Betkowski, Alberta Health Minister, in the October 19, 1992 issue of *Alberta Report*, indicated that health care has risen from 21% of the provincial budget in 1980 to 31% in 1992. She said "it can't continue to grow at that rate." To put these numbers in perspective, the provincial budget has risen over 30% in just 6 years[1].

A chronology of the problem from January 1, 1990 to December 31, 1994 illustrates the development of the crisis and the means adopted to address the crisis. The information was taken from articles in the Edmonton Journal. Early 1990 saw significant events which directly affected the developing crisis in health care funding and thus January 1, 1990 was chosen as the starting point of the chronology.

January 3, 1990. It was reported by Alberta Health that the number of doctors in the province increased by 20% from 1983 to 1987 while the population remained steady. This resulted in a dramatic increase in Medicare payments to doctors.

January 8, 1990. The Misericordia Hospital reported that it was in "a financial bind" and was asking the public to assist in determining where to cut. An Alberta Health document was leaked to the press. It carried the suggestion that 9 regional health authorities be created to manage hospitals.

February 5, 1990. It was reported that people were dying because they could not survive the waiting lists. Specifically, heart by-pass patients had a long wait for service.

February 8, 1990. The provincial government was asked to take over the management of the High Level hospital.

February 14, 1990. Premier Getty promises not to place restrictions on access to health care.

February 17, 1990. Nurses announce that they will seek a 50% increase in pay. Hospitals offer 20%. This was the first contract negotiations undertaken by the hospitals. Previously the government negotiated the nurses' contracts.

February 25, 1990. Nurses quit talks despite pay offer.

March 6, 1990. The University of Alberta Hospitals closes 18 beds and the main operating room due to government grants falling short of operating costs. The Royal Alexandria Hospital closed 55 beds the previous October for the same reasons.

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[1] Province of Alberta 1992 Budget Address

March 9, 1990. Radical changes to hospital funding announced. A new funding formula is introduced which relates the funds received by a hospital to its performance against the provincial average. The University of Alberta Hospitals stands to lose $2.5 million in funding based on this new formula.

March 10, 1990. Doctors given a 2.9% increase raising average pay to $120,474.

March 22, 1990. Alberta nurses receive a 19% raise and become the highest paid in Canada. The pay increase negotiated by the hospitals was not included in the provincial grants for the year. This would become a major factor in re-allocation of hospital budget funds in the coming months.

March 23, 1990. The Provincial Government raises health care spending by $240 million to $3.8 billion, a 6.3% increase.

June 30, 1990. The province gives hospitals an extra $47 million to cover extra costs for nurses. This grant only covered 90% of the increase. Charles Camsell Hospital announced the closing of 65 of 273 beds to reduce their deficit. With a 6.3% increase in funding supplemented by an additional $47 million, hospitals began laying off staff and closing beds in the first 6 months of 1990.

July 31, 1990. Hospitals faced a looming cash crisis, with shortfalls of up to 30%. Alberta Hospitals Association Vice President John King said that service reductions would result. He stated that the options available were limited to closing beds, reducing service and eliminating programs. This was the first public use of the word "crisis" to describe hospital operations.

August 1, 1990. The Alberta Medical Association wants the province to admit that there is a crisis in health care funding, specifically for hospital funding. Hospitals are being forced to close beds and slash budgets. "Slashing budgets" was not clearly defined, as hospitals were actually experiencing increases in funding at this point.

August 4, 1990. The University of Alberta Hospitals closes 18 beds and lays off 40 staff.

November 3, 1990. Psychiatrists say that people must wait months for care due to the cuts, and that a constant crisis situation exists (Dr. L. Wancke, Grey Nuns

Hospital).

November 6, 1990. The University of Alberta Hospitals lays off 100 staff and closes 45 beds to cope with the 3% **increase** in funding. The hospital has 1355 beds, 842 of which are acute care, 5000 employees, 2300 of which are nurses. Edmonton General Hospital and Grey Nuns Hospital let go 35 of 500 staff. This included both nursing and non-nursing staff.

November 7, 1990. Nurses break into tears as they face lay offs and transfers.

November 15, 1990. Nancy Betkowski, hospitals minister, moves to quell a hospital revolt. Some hospital boards are refusing to balance their budgets. The University of Alberta Hospitals announced that it cut $9.6 million from its budget and laid off 179 staff. "Cuts" in this context does not refer to overall budget, which was up from the previous year, but to specific programs and areas to allow for the deficit caused by the large settlement with the nurses.

November 17, 1990. Another Alberta hospital defies the government order to balance its budget.

November 29, 1990. Nancy Betkowski issues an ultimatum for hospitals to balance their budgets "or else." The 3% budget increase left hospitals struggling.

December 4, 1990. The crisis in psychiatric wards is listed as the cause for two deaths.

December 14, 1990. The Health Minister fires the Two Hills hospital board for failing to deal with its deficit.

December 19, 1990. The Health Minister sends a deputy to the Royal Alexandra Hospital to deal with unacceptable emergency service. The hospital had cut 113 beds, 12% of total, in a cost cutting exercise.

The end of 1990 saw the beginnings of the crisis. The approach to dealing with budget increases which were below desired levels was to reduce service, close beds and lay off staff. Concern was raised by the medical community that more funding was required, and was the answer to the problem. This response was consistent with the expectations of Freidman (1983), where a publicly funded system will strive to maintain the status quo in the face of proposed change.

January 5, 1991. The province announces that hospital grants will increase by 3.5% in 1991, below the rate of inflation.

April 5, 1991. The provincial budget confirms the allocation to hospitals.

April 10, 1991. The proposed children's hospital is cancelled. Existing facilities will be adapted.

July 4, 1991. Larry McLennan of Alberta Health reveals that the province is proposing an earnings cap on Alberta doctors.

July 11, 1991. The 10 provincial health ministers release a report calling for ceilings on doctor's earnings.

October 8, 1991. Cutbacks for services are needed according to Treasurer Dick Johnston.

October 10, 1991. The Treasurer announces that the balanced budget sought for Alberta is in trouble.

November 13, 1991. Premier Getty announces that health and education may be cut.

November 23, 1991. Consumer and Corporate Affairs Minister Dennis Anderson says that a cut of 25% in health and education may be required to balance the budget. This is the first mention of a significant reduction in health care funding. Previously, announcements talked of reductions in the rate of increase.

The end of 1991 closed a year where the provincial government began expressing a desire to actually reduce funding to health care in order to deal with the provincial budget deficit. No firm plans were announced. Significantly, a potential target level of a 25% reduction was introduced near the end of the year.

January 10, 1992. Premier Getty announces that another year of restraint is required for health care. The budget will only increase by 4% in 1992. Larry Odegard of the Alberta Health Care Association says the result will be lay offs.

January 29, 1992. The Health Minister is looking to cut the surplus of doctors by reducing the number of medical students by 10%.

April 14, 1992. The provincial budget is released with health care budgets increased by 2.5%.

May 9, 1992. Provinces rethink the "high tech" health care approach. Consolidation of these services in Edmonton and Calgary is considered.

December 5, 1992. Ralph Klein is elected Premier.

December 24, 1992. The new Provincial Treasurer, Jim Dinning promises to do a better job in reducing the deficit. Premier Klein promises to balance the budget in 4 years.

The year 1992 was quiet in the area of health care. Hospitals had adjusted to the reduced rate of increase through some small scale lay-offs and bed closures. There were no announcements as to potential changes if the government were to proceed with an actual cut. The key event of 1992 was the selection of Ralph Klein as Premier. His new Treasurer expressed a commitment to reduce the deficit.

January 20, 1993. Premier Klein announces that the previously announced 2.5% increase in health care funding will not happen, there is to be no increase in 1993. Larry Odegard of the Alberta Health Care Association says that this will lead to lay offs.

January 28, 1993. Jim Dinning announces that Alberta's budget deficits are becoming "dangerous."

February 3, 1993. Caritas Health Group announces 79 lay offs to compensate for the zero increase in budget.

February 6, 1993. Anger and fear are displayed by hospitals staff and nurses as budgets are "slashed." United Nurses of Alberta representative Heather Smith says the last two years have seen a reduction of 3-400 nursing jobs as a results of the cuts. The rhetoric began heating up in the press, as the period quoted actually saw increased budgets, not cuts.

March 3, 1993. Funding freeze "hammers" hospitals. Larry Odegard says that lay offs and long waits will result from the zero increase. The outcome would be reduced care. Premier Klein stated that it would be up to hospitals to find ways to streamline their operations. Ron Hodgins of the Alberta Health Care Employees Union indicated that scaling down cannot continue. He said that there is no alternative to scaling down.

May 7, 1993. Jim Dinning cut $127 million from health care. This is the first time in 5 years that funding has been cut. Unions and hospital boards are given the choices as to where to cut.

May 17, 1993. The Alberta Medical Association President Wayne MacNicol said that doctors do not want to take cuts to help with the deficit problem. They say that hospitals could be closed and services reduced with the existing budgets situation. Heather Smith of the United Nurses of Alberta said that nurses are in an "atmosphere of terror".

July 13, 1993. Premier Klein announces that $64 million more will be cut from health care budgets, and suggest that cuts come out of administration costs. Larry Odegard said that the government should not get involved in the running of hospitals, and should leave it to hospital administrators. Wayne MacNicol of the AMA said that hospitals have yet to implement the previous cuts. He suggests that the cuts will impact access to health care. He was also concerned that the system cannot become any leaner. Cathy Ducharme of the University of Alberta Hospitals said that restructuring has been in the works for 3 years.

July 15, 1993. Don Schurman, the President of the University of Alberta Hospitals says he thinks they can handle the cuts, but need time to figure out how to do it.

By the middle of 1993, cuts to actual budgets have become a reality. Articles in the media have shown a lot of posturing, with the health care community's general position being that the cuts cannot be accommodated without significant reductions in service. Don Schurman of the University of Alberta Hospitals is the notable exception. His concern is the time requirement to meet the challenges. He feels that the University of Alberta Hospitals' TQM approach will ultimately reach a workable solution.

July 26, 1993. Malcolm Brown, a University of Calgary economist, says that consumers will be the biggest losers from the budget cuts. Don Schurman of the University of Alberta Hospitals says that one half of the necessary savings will be from waste reduction, while the remainder must come from re-design of the system so that patients do not need to stay in the hospital. He also stated that some hospitals may need to close.

July 29, 1993. The Royal Alexandra Hospital proposes pay cuts to ease lay offs. The union is considering a 6% cut.

August 23, 1993. Unions at the Royal Alexandra and Charles Camsell Hospitals brace for lay offs of as many as 20% of jobs.

August 24, 1993. The Royal Alexandra Hospital cuts 186 jobs and closes 90 beds. Wayne MacNicol of the AMA says that the government can not slash health care costs without threatening basic health care needs.

August 30, 1993. Jim Dinning announces the need to re-engineer and restructure the way things are done in education and health care.

September 17, 1993. The University of Alberta Hospitals announces cuts of 280 jobs and 80 of 740 beds. To date this year Caritas has cut 72 beds, the Royal Alexandra has cut 192 beds, the Charles Camsell cut 8 and the University of Alberta Hospitals has cut 170 beds.

October 8, 1993. Catholic hospitals have cut 400 jobs and closed 82 beds. They say that unemployment is not the solution to the health care cost problem.

October 9, 1993. Funding cuts may force hospital closures. Don Schurman says that there is little slack to accommodate future cuts.

October 13, 1993. The war on the deficit will cost 12,000 jobs according to Heather Smith of the United Nurses of Alberta.

October 15, 1993. Heather Smith says that she believes that the government will not actually go ahead with 3 more years of cuts. Stockwell Day, labour Minister, gave unions until November 23 to come back with a roll back proposal.

December 9, 1993. Hospitals are to be run by 10 to 15 boards rather than the 200 currently in existence. This is to take place within one year according to Diane Mirosh, minister in charge of the Health Planning Secretariat.

December 15, 1993. A week long series discussing the health care crisis begins in the Edmonton Journal. It is revealed that health care spending has been growing at almost twice the rate of inflation for the previous 10 years. The week long series focused on the lack of a solution for the health care funding problem.

The close of 1993 saw the health care funding situation develop into a crisis. Actual cuts were introduced. Hospitals and health care professionals seemed to be caught unprepared. The result was beds closures, staff lay offs and program changes. Rhetoric heated up with warnings from the health care community that service would suffer, and that options were limited.

January 4, 1994. Hospitals announce that they will absorb the proposed 5% cuts to keep employees, but are unsure how, according to Charles Vermeeren of the University of Alberta Hospitals.

January 18, 1994. Premier Klein announces a further $175 million in cuts, targeting a 17.6% reduction in health care costs.

January 20, 1994. City hospitals bear the brunt of the cuts. Gordon Tutle of Alberta Health said that the city would lose 30% of its funding over 4 years.

February 2, 1994. Charles Camsell Hospital to close.

February 10, 1994. The province is to "call the shots" on hospitals. The Grey Nuns is to close as an acute care facility.

February 25, 1994. Hospital bed closures will continue until 1996-97.

March 6, 1994. Nurses union vows to fight the expected roll backs of 10%.

April 2, 1994. The official announcement that the Grey Nuns Hospital will close as an acute care facility.

April 3, 1994. The province announces that there will be only three full service hospitals left in Edmonton.

May 5, 1994. A deal is announced to trim doctor's pay.

May 19, 1994. Alberta Hospital cuts 100 employees.

May 21, 1994. The University of Alberta Hospitals announces lay offs of 200 and 18 bed closures.

June 2, 1994. The government announces that patients will have to pay for more services as doctors take a pay cut.

June 3, 1994. Caritas to reduce the Grey Nuns budget from $80 million to $53.7 million. The 12 bed intensive care unit is cut in half. This is part of the $150 million metro-Edmonton budget.

July 16, 1994. Larry Odegard says that cuts will cause disruption of service and longer waits for service.

July 24, 1994. The Grey Nuns is ill equipped to handle a crisis, and doctors say the public is misled regarding the ability to provide adequate service.

August 20, 1994. Intensive care service a problem according to Dr. Ron Wensel of the University of Alberta Hospitals.

August 21, 1994. A nursing shortage is announced at the University of Alberta Hospitals. Louise Rodgers of the Staff Nurses of Alberta says that the cause is poor planning.

August 23, 1994. The "horror of the week" campaign begins. Health care workers begin reporting incidents to highlight damage to health care caused by the cuts.

August 27, 1994. Caritas reduces the beds at the Grey Nuns Hospital to 130 from 520, and closes intensive care at the Misericordia.

September 3, 1994. Doctors fear a trauma unit overload as there are only 2 units left in Edmonton.

September 4, 1994. The Royal Alexandra Hospital plans to lay off 100 staff. Nurses reject a proposed pay cut. Dr. Tom Noseworthy stated that to this point they ran a deficit to protect programs, but cannot continue.

September 10, 1994. Concern is announced that one half of the University of Alberta Hospitals nurses will be replaced by lower skilled workers. American Practice Management Ltd., a consulting group working with 500 hospital employees released some details on the proposed re-design. They propose that nursing staff ratios be changed from 90% registered nurses, 10% practical nurses to 60% registered nurses, 40% practical nurses to free up nurses for nursing tasks. The study has taken approximately 1 year already and continues.

September 15, 1994. From 1990 to date, one half of the city's hospital beds are closed.

September 24, 1994. Doctors say it is time to stop the cuts. They express concerns over the ability to provide service (Fred Moriarty, AMA), and say that patient care will deteriorate.

October 6, 1994. Hospitals cut another 950 jobs. 600 beds in the region to close, 3 more hospitals to lose intensive care facilities. Brian Levon of the Capital Health Authority says that job losses are unavoidable to meet the budget.

November 18, 1994. Medicare coverage reduced.

November 19, 1994. The University of Alberta Hospitals to lay off 250 more nurses. By the time the re-design complete, 30% of nurses will be gone.

The pace of cutting back accelerated in 1994. The University of Alberta Hospitals began a serious redesign program to address the cuts. This was the only announced attempt to change their system to maintain as much service as possible while meeting the financial constraints. The rhetoric continued to focus on the danger the cuts posed to the community. Those within the health care system offered no suggestions as to how the system could be redesigned or changed to effectively cope with the new funding levels.

The province had implemented the new system of a limited number of regional hospital boards to manage the regional systems, but offered no specific design alternatives for the system. The individual boards and hospitals were left with the task of determining how to change and adapt to provide adequate health care under conditions of restraint.

The events show that hospitals were placed in "crisis" conditions as outlined in the opening definition. The University of Alberta Hospitals was the only one which held any hope for meeting the challenge of redesigning their system to provide desired service levels at reduced funding levels. The standard response over time was shown to be one of cut back in staff, beds and services to reduce costs as the reductions were announced. There were no reported pre-emptive changes where hospitals had strategies in advance of the cuts. The hospitals responded directly to changes in funding, but not to the announcements that funding reductions were desired. The general approach over the five year period from 1990-1994 inclusive was wait, see, react.

Cost Improvement Initiatives and Results

The provincial government introduced a new funding formula in 1990 in an attempt to force hospitals to adopt more efficient treatment methods. The formula develops a cost profile for each hospital based on the types of patients treated. The formula compares the treatment cost for patients based on the classification of the patient according to ailment and a comparison to a standard expected cost. The formula gives a comparative rating of each hospital relative to the others which is used to determine funding for the year.

This new funding method caused problems for a system which has grown used to regular funding increases. The new funding formula placed hospitals in competition with each other on a year over year basis. Hospitals with above average productivity were to receive increases in funding, while those below average receive cuts. The main strategy to "win" is to generate the greatest possible improvements as fast as possible, as you cannot know how much the competition is improving. This fits with Ford's criterion of a threat coupled with time pressure. It also meets the other stated criterion that productivity is the major issue to be resolved.

The basis for this new formula is the concept of Diagnosis Related Groups (DRG's) (Fetter, 1991) which relate treatment costs to severity of illness and other factors.

The use of DRG's is a controversial issue, with arguments for and against being presented by Roper (1987) and Primich (1987). The argument for is that DRG's are an effective tool for managing costs without compromising quality. The argument against is that it is cumbersome and unmanageable to have meaningful classifications for patients. The system is open for abuses as well. It is agreed, however that costs are a problem.

The new Alberta formula used Case Mix Groups (CMG's) which group patients according to illness and severity (Kaul, 1992). The patient treatment costs for each group are compared to a standard cost base for each group, and a weighted total is determined. This was used to calculate a "Hospital Performance Index" used to compare hospitals' performance.

In 1993, the government under the new premier, Ralph Klein, abruptly changed the funding for health care and dropped the formula. A direct funding approach was used. The total system funding was significantly cut and several hospitals were closed. The administration system was integrated in hopes of reducing costs. The approach taken was strictly to reduce costs, with consideration for service given second priority.

Progress in Dealing with the Health Care Cost Crisis

The literature suggests that there has been little progress in dealing with health care costs. An issue raised by Morrison (1992) and Milakovich (1991) was that providers of health care resist efforts to change the processes for the purpose of improvement. This issue is serious due to the lack of accountability (Hodge, 1991) in the system. Strong resistance coupled with no clear accountability works against the principles of TQM, thus significant improvements may not be possible. Within this backdrop, there is little chance for significant reductions in both unit costs or total costs, as no serious system changes are being considered.

Jackson (1992) points out that hospital staff need to understand processes before they can be improved and costs reduced. Many programs are failing because the staff do not understand the processes under their control. This is supported by Hodge (1991) and Stoddart (1992) who also point out that processes are not understood by those performing them.

With all the efforts undertaken to control costs and provide more effective health care in the U.S., Berman (1992) offers some sobering comments. He states that with all. the cost pressures, cost containment programs have had a few failures, and no long range successes. His work focuses attention on changes to insurance and community based planning. No suggestions are made regarding process or structural changes.

Research by Rakich (1991) raises concerns about using, in Canada, methods currently in vogue in the U.S. This research found differences in the funding and control systems between the two systems. This indicates that there may be the need to define different customers in each system. Another finding was that the Canadian system is more efficient. This raises the question as to why Canadian hospitals are following U.S. methods in cost reduction. Canadian hospitals are also more stable than their U.S.

counterparts who have greater uncertainty of revenues.

A survey by Anderson (1992) shows that only 4% of Canadian health care institutions always or almost always use process simplification to improve business practices. This research also indicated that Canadian institutions are ahead of their American counterparts in adopting cross functional teams as a means of addressing problems.

Alberta hospital administrators are now seeking ways of reducing unit throughput costs, and the evidence suggests that they hope TQM will do it. This management change is currently being implemented in several larger hospitals. Their efforts so far have not generated significant results.

Hadubiak (1993) researched the problems of implementing TQM in healthcare institutions in Alberta. The Caritas Health Group changed its focus from the "hard" issues of cost, procedures and control to the "soft" issues of patients, people, teamwork, and quality. After the first round of budget cuts, one facility was shut down and the remaining facilities were scaled down. At the same time, this organization was recognized as a leader in applying TQM in healthcare in Canada. A lot of time and effort was expended but with no measurable improvement in productivity.

The University of Alberta Hospitals was a 1355 bed hospital system with over 6,000 employees. This organization considered the patient as the customer and developed performance measures to reflect this view. Two years into the TQM program, the first round of layoffs occurred forcing a halt to the implementation. The implementation was re-instituted with marginal results just before the second round of major layoffs occurred.

The hospital is struggling to quantify the progress of the improvement methods. The view of the patient as a customer may be a problem, as it is the government that provides the funding. The patient and the government may have conflicting objectives. This has not been established scientifically, but the evidence is that despite efforts at improvement, patient costs have not significantly dropped but revenues are dramatically reduced.

During the layoffs, managers were informed that not all would survive the change. Efforts were made to relay this information in a sensitive and appropriate manner, but morale plummeted (Hadubiak, 1993). Most physicians wanted to see evidence of success before embracing the TQM concepts, compounding the problems of implementation.

Table 2.2 shows the results of quality improvement projects at the University of Alberta Hospitals as they were reported by the Quality Assurance group in 1992. The reporting does not give an indication of proportion of overall improvement relative to global budgets, and does not indicate the cost of obtaining these gains. While the efforts made gains, the net result was a reduction in funding of $2 million on a budget of $250-300 million. While the documented improvements are worthwhile, they did not prevent the hospital from receiving a funding reduction and initiating layoffs.

While these are improvements, they pale alongside the hospital's $250 million per year operating cost. Further, most of the savings realized were "soft dollar" savings which increased overhead by introducing more slack time into the process. That is, with the same number of staff and no more patients handled, actual costs realized remained about the same. The "hard dollar" savings were not significant when measured against the overall budget. This information illustrates the lack of success in making breakthroughs which will make significant positive impacts on the hospital funding.

The results below were reported in 1992. The University of Alberta Hospitals Annual Report of 1992-1993 highlighted the effectiveness of the TQM program and the team building that had occurred, and the move to increase patient satisfaction.

1.	Total Hip Replacement: 21% reduction in resources used
2.	Cholecystectomy: 23.1% reduction in resources used
3.	Respiratory Therapy: $18,886 reduction in yearly operating costs
4.	Photography and Medical Illustration Staff: 57% increase in output with no staff increase
5.	Switchboard: reduced abandoned calls on Saturday by 14 calls per hour
6.	Human Resources: $200,000 reduction in grievance arbitration costs over 3 years
7.	Pharmacy: decreased spending on Omeprazone by 40%
8.	Central Sterile Service: shift hours reduced by 1/3
9.	Medical Records: savings of $1,000 per year
10.	Obstetrics: decrease Cefoxatin use by 80% using a cheaper drug
11.	Linen Services: increased production by 10%
12.	Nutrition & Food/Materiel Management: decreased food purchasing paperwork by 50%
13.	School of Nursing: reduced time for requisitioning library books from 1 week to 1 day
14.	Surgical Suite: decreased last minute cancellations through pre-planning
15.	Occupational Health and Safety: safety tours conducted by Vice-presidents, safety audit tool developed
16.	Food and Nutrition: eliminated staff "sign out", new nutrition charting form developed, reviewed and standardized dieticians clinical responsibility, new packaging for muffins
17.	Heart and Lung Transplant: updated patient teaching manual, developed a patient self-administration medication record
18.	Pastoral Care: flow chart to improve admitting chaplain residents, interview committee for new residents
19.	Rehabilitation: unit producing personnel productivity index up from 70 to 78%, attendances per worked day up 21%, supply costs decreased
20.	Quality Improvement and Education: now use a stamp rather than a memo to pay invoices
21.	Administration: central filing system, voice mail

Table 2.2: Hospital Improvement Project Success Stories

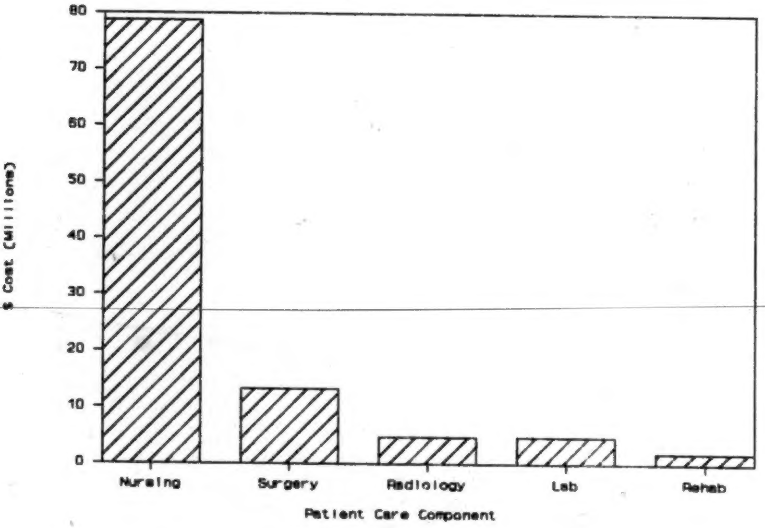

Figure 2.2: Pareto Chart of Patient Care Costs

A Pareto Chart is a tool of TQM used to focus effort and attention. Since the reported projects to date are in the "Lab" and "Rehab" categories, it would seem that TQM is not being used effectively to address the major problems faced by this hospital. Further, there seems to be problems in implementation. At another hospital in Edmonton, Larraine Barby, a productivity consultant[2] working for the Caritas Health Group, stated "the TQM program is getting in the way of productivity improvements. Everyone is focused on the process, not the results."

Another serious threat to successfully addressing the cost issue is the "shotgun" approach to implementing TQM systems. Local hospitals are trying to implement TQM at every level in the organization before determining the most serious needs or concerns which the organization may have. This is somewhat akin to proposing a fitness program for a person who has just been hit by a bus. The patient is not stable enough to handle the program. Mr. Doak, from Dow Chemical[3] commented that you must first address the major "pain" before a continuous improvement system can have meaning.

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[2] Meeting, August 20, 1992

Hadubiak (1993) concluded that at a practical level, TQM may not work in a hospital environment. Health care professionals are concerned that mandated change will happen if voluntary change does not. This fear is being borne out with the current changes in policy whereby the government is taking more direct control over health care.

In his review of the TQM applications at the University of Alberta Hospitals and the Misericordia Hospital, Hadubiak concluded that the high degree of education is also a problem. Worker feedback showed that the workers want to make their own decisions but they do not necessarily wish to act in the best interests of their organizations or the public. They feel that a change of government is all that is needed to address their problems. Ironically, while the workers wish more autonomy for themselves, they have adopted a paternalistic approach to their patients. The conclusions of Hadubiak's research strongly support the accepted sociological views of Chapter 3, where the idea that management should establish targets is developed.

The 1993-94 Annual Report for the University of Alberta Hospitals described the re-design project which had been undertaken. It involved a consulting firm and 500 employees, and would take over a year to complete. The focus was to reduce the amount of time a patient needed to spend in the hospital. Concern was expressed by President Don Schurman that the system may not survive the transition intact.

Mr. Schurman reiterated his commitment to TQM and the teamwork principles. Subsequent to this time, the hospital's board was taken over by the Capital Health Authority, and a new administrative structure put in place.

The Chairman's Report in the same Annual Report stresses the reality of reform, "doing more with less."

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[3] Meeting, July 7, 1992

2.7 Synthesis

The previous information discussing the Alberta health care funding problems indicate that organizations in that sector meet the definition of crisis as set out in Chapter 1. Contrasting crisis management approaches with accepted normal operating practices in management literature and with systems design concepts suggests new approaches to successfully addressing crises might result from integrating and extending non-crisis management and systems methods for use in crisis situations.

The literature indicates that time pressures are increasing, and that crises are becoming the norm. Existing methods for addressing crises quickly take stock of the situation and focus on cost and expense reductions to improve short term cash flows. Resulting changes are usually "quick fixes" which do not lead to long term improvements.

Downsizing, job redesign and re-engineering also have costs as priority. These efforts focus at the process level to obtain cost reductions which lead to productivity improvements. The methods discussed in the literature do not allow for the complex interactions within the organization, and temporarily suspend concepts such as "customer focus."

In contrast, TQM and other current management methods place priority on the customer. Process improvements are continuously sought to improve value to the customer. Tools such as QFD, as introduced in Section 2.3, are used to link customer needs through the organization and its processes. TQM is effective in controlling and improving existing organizational structures and processes by involving employees.

Nadler considers the whole organizational system in the context of its "purpose." This becomes the key constraint in determining actions or changes. This is similar to TQM in that it is an outward or external focus. The "purpose" of the organization is connected to the customer, as customers are necessary to achieve the overall "purpose." Changes, according to Nadler, begin with the development of a "target." Development of these "targets" should be undertaken with a minimum of constraints, and be driven by the "purpose."

Ackoff has a systematic view complementary to Nadler's. It is also externally focused and purpose driven. Changes must be made in the context of their potential interactive effects on the whole organization. Within Ackoff's procedures, management must develop its own plans to be used as default positions which can either be implemented or used as benchmarks for employee generated alternatives.

Goldratt is consistent with both Nadler and Ackoff in that he proposes a method of prioritizing of processes within an organization in terms of overall effects. The measurement is based on net contribution. He suggests that the "goal" of an organization is to maximize the accumulation of net returns. This leads to the consideration of net revenues as a major priority. This also implies a linkage to customers as in TQM. Goldratt also suggests that costs and cost changes can only be considered in the light of changes to net revenues. The whole system and its interactions are to be considered, as with Ackoff.

Within the context of determining changes, ABC accounting concepts provide a useful tool. Nadler has suggested that minimum amounts of data or information should be gathered to determine a course of action. Existing cost reduction based methods focus on detail cost data. ABC provides a useful linkage between activities, time based resource costs, and outputs. Rather than use as a tool for assigning overheads, these concepts may be extended to provide a proportional measure of alternatives considered for given activities. In this adaptation, it becomes a useful tool in process redesign.

According to the literature, crisis management techniques have a low success rate and lack of long term lasting effects. In contrast there are successful systems design methods and elements of management practices such as TQM which have been used in non-crisis situations. This suggests studying the potential for extending, developing and adapting these successful methods to the area of crisis situations. It suggests that synthesis of the successful approaches and techniques discussed above provides an alternative framework for crisis management.

Nadler has suggested that design or redesign efforts should begin with a "target." This target should be driven by an overall purpose, or as Goldratt would say a "goal." Goldratt's "goal" is a measure of net return to the organization, which is the key driving priority. The customer should be considered in any change affecting output, as this is the source of revenue. The key measure of customer involvement is thus revenue, which is the highest priority. This suggests that any process for change requires prioritization before change, and that interactive effects be allowed for based on the relative priorities.

Revenue forms the key priority in any change, and costs should only be considered in light of the effects on revenues. Revenue effects must somehow be linked to the overall organizational system in such a manner as to reflect these interactions. The TQM tool QFD, as represented by the "House of Quality" is a matrix method which is used to link the customer to all organizational sub-systems and processes. An adaptation of this tool could be used to link revenues with the components of an organization, retaining the key interactive linkages as well.

The linkages illustrated in this matrix approach would thus yield a means of prioritization of all components for change based on this linkage to revenue. The methods of Goldratt provide the basis for development of decision rules to facilitate this prioritization. This would overcome key shortcomings in current crisis management methods, that is a lack of relative prioritization and allowance for interactive effects.

Successful prioritization of an organization for the purpose of developing changes leads to the process of determining changes. Application of ABC as a relative cost tool may reduce the data requirements and facilitate a rapid comparison with the potential for reduced research and study requirements.

The final synthesis of these concepts is a "targeting process" which is driven by purpose, maintains a linkage to the customer, prioritizes based on net revenue effects and uses activities as a relative measure for costs.

CHAPTER 3: RESPONSIBILITY

3.1 Introduction

The first proposition to be presented in this research was which individuals should set the targets. In this chapter it is argued that senior management should undertake to develop the targets for major change. Addressing of this issue should precede any steps in actual development of a potential target for change.

The issue of who should determine the targets for system productivity improvements is important in an organization. Deming (1980) indicates that management is responsible for the system. However, there is some divergence in thinking between current management literature and accepted sociological research as to responsibility for both design and conduct of the system. Much of the current literature focuses on "empowering" employees, but most applications are in the area of process improvement, not systems re-design in time of crisis.

Empower and empowerment have the following definitions according to the Webster's Third New International Dictionary[1]:

Empower: to give power or authority to; to enable, permit

Empowerment: the act of empowering or state of being empowered

Current management strategies such as Total Quality Management (TQM) strongly promote the concept of empowering employees, enabling them to establish their own performance goals and requirements, in a loosely constrained environment. In this environment, there is less reliance on performance standards being set from above, in accordance with Deming's 11th point (1980).

Covey (1991) is a strong supporter and advocate of empowerment, but stresses that there are requirements and conditions for empowerment to be successful. These are summarized as "guidelines for successful empowerment" in section 3.3.

There have been both successes (Adler, 1993) and failures (Ernst & Young,

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[1] Webster's Third New International Dictionary, Volume 1, A to G, Encyclopaedia Britannica, Inc., Rand McNally & Company Inc., Chicago, Illinois.

1992) in the application of empowerment as a means to more competitive organizations. Rather than supplant or displace current thinking, this research seeks to add new dimensions to the problem of successful application of empowerment in organizations. The discussion of how and when to set goals and performance standards needs an understanding of the empowerment issue.

Sociological theory which provides indirect support to management literature is presented[2]. This theory is representative of North American culture, where individualism is a major factor. While empowerment may work in specific applications, it is not clear whether it will work in the general case, or more specifically, in a crisis situation[3]. The research in this chapter will show:

- Empowerment is constrained and is a case of degree.
- Successful empowerment may not be just a function of management expertise and corporate culture and may depend on societal culture and social nature of employees as much or more than management.
- Empowerment may not be appropriate in times of crisis.

3.2 Crisis Conditions

Hirshhorn (1988) suggests that the "social defense" mechanism within workers makes it difficult for empowerment during times of crisis. The workers do not want to take responsibility for unpleasant tasks. In times of severe crisis, the behaviours may even become irrational and destructive.

This research also shows that traditional organizational theory has not properly linked uncertainty with feelings of anxiety. Anxiety in turn triggers various social defense mechanisms. Some of these mechanisms are following rules, considering the job as an end in itself rather than a means to other ends, giving authority to rituals and rules, and following orders. As risks to the organization grow, so do anxieties. People create social defenses to reduce anxiety. These can cause irrational behaviour in the work place.

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[2] Comments from Dr. R. Morrow, University of Alberta Sociology Department, September 9, 1996.

[3] Comments provided by Dr. D. Hurst, University of Alberta Department of Sociology, September 23, 1996.

Anxiety can cause alienation and distorted relationships at work. Workers retreat from roles, tasks and organizational boundaries. Work is de-personalized, and capacity to accomplish primary tasks is distorted. The relationship between the group and the environment is also distorted. This leads to scapegoating, delusions and fantasy regarding what is actually happening in the organization. The worse the situation, the less likely that it will be effectively confronted.

In extreme cases, the scapegoating will become severe and primitive. This creates an imploding world with ever increasing levels of anxiety. While there is a basic drive to try and repair the damage to the relationships, the situation tends to make things worse. The resources required for management to restore the psychological balance are generally outside the scope and power of the organization.

Hirshhorn goes on to say that vicious circles of anxiety can be created, and leadership can be a real problem. The quality of leadership becomes critical. The workers need to see strong leadership. In an uncertain environment, there are contradictory forces at work, and management needs to provide leadership to reduce the anxiety levels.

3.3 Causes for Success and Failure in Empowerment

There are successful applications of empowerment such as the NUMMI plant (Adler, 1993). In this case, employees had been through the recent trauma of a plant closure. There is a very clear focus for employees as to what they must do. Those who have faced a closure have undergone a psychological experience which they probably do not wish to repeat, while those facing a closure may undergo a shift to survival thinking. Cases of downsizing or other crisis may not invoke the same response, as the employees may not realize until actual closure that the crisis is real.

Unfortunately, it is easier to find failures of empowerment than successes, as evidenced by the Ernst & Young report (1992). The report which covered over 700 implementations of Total Quality Management (TQM) and found that more than 80% of the applications failed. TQM relies heavily on empowerment methods. A look at some causes for failure of empowerment (Figure 3.1) may give a view to limitations of empowerment and when it should be attempted.

If we apply a simple application of a fish-bone chart and some of Senge's (1990) system logic, we can develop other sources for these failures. Figure 3.1, a fish-bone chart, illustrates that there are external causes besides management and employees responsible for the failure of these programs.

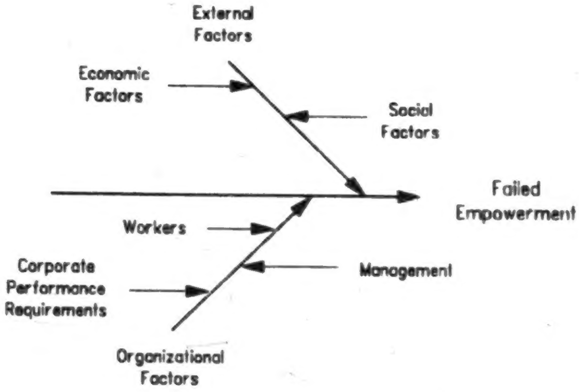

Figure 3.1: Factors Affecting the Degree of Empowerment Within an Organization

The external factors include things such as competition, product life cycle, the age and condition of the plant relative to current industry standards and supply factors. The efficacy of the plant and equipment is tied closely to economic factors external to the firm such as the current state of the art. The impacts of technological development are external economic factors that may have an effect on the success or failure of any empowerment program.

The traditional TQM view would place the responsibility for these failures with management (Deming, 1980). Considering the influences of management and employees on each other gives some insight into why both may be causes. For success, both must participate positively. Either may cause failure. The question also arises as to whether influences external to the organization are significant enough to insure failure. With these potential causes for failure identified, a further question of if, when and under what circumstances should empowerment based systems be attempted, and to what degree. The likelihood of success should be addressed while determining the degree of empowerment to be applied, from zero to full autonomy.

Covey (1991) provides guidelines for determining whether empowerment can succeed or not. He has articulated 6 criteria for successful empowerment:

1. Character. Integrity, maturity and "abundance mentality"[4] are required.
2. Skills. Communication, planning, organization and synergistic problem solving skills are needed.
3. A win-win agreement. Employees and management both need to win in the arrangement. The agreement includes the desired results, guidelines and policies, resources available, accountability and consequences.
4. Self supervision. The people of the organization need to be capable and willing to supervise themselves and produce the desired results.
5. Helpful structures and systems. The organization has to have a structure which supports empowerment.
6. Accountability. All involved have to be accountable for their behaviours.

3.4 Organizational Constraints

There are arguments related to economic reality that throw the issue of empowerment into doubt. These are related to "facts with respect to survival." In discussing goal setting, Deming (Perisco, 1994) refers to "facts" with respect to survival as acceptable requirements for outputs. Increased levels of competitiveness will reduce the latitude available to firms to set performance targets. As a consequence, employees may have less input.

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[4] "Abundance mentality" refers to a philosophy that there is no scarcity of resources or constraints to options in the long run.

According to Perisco, employees should participate in goal setting, with valid goals being set based on corporate data. This is consistent with Management By Objectives (MBO) which reaches agreed upon goals and performance targets which must be achievable, measurable and time constrained (Marlow, 1991). One key assumption in this process is that there be choices available. Firms in distress do not have as many choices, and have "do or die" requirements to insure survival. In this case, performance requirements are set and are not negotiable, except perhaps upward.

A more sublime logic relates to the reason for creating the organization in the first place (Goldratt, 1984). The organization is started for a purpose, which may be in part a function of the culture of the owners. Achieving this purpose requires some outputs. According to the purpose, a system is designed to generate the outputs, and staffed accordingly. Management is responsible for creating and maintaining the system (Deming, 1980). By the time the staff is in place, the processes have been generally determined. In this sense, employees, even when empowered, have very limited ability to change their jobs. Tasks will largely be determined by product specifications and resources available. Management does not have to tell the workers how to do their jobs, as there is usually not much choice.

3.5 Management Manipulation: Illusory Empowerment

If we accept the assumption that firms have objectives which require minimum levels of productivity and production, and that the market places additional pressures, we have a situation where one or the other is constraining. If management is aware of this, they will seek to stay ahead of market pressures. The only way to do this is to actively push for greater productivity to give more room for variations in external economic factors. There will be both implicit and explicit targets to be met.

Edwards (1979) suggests that hierarchy exists in an organization because it is profitable. Conflict exists, according to Edwards, because the interests of the workers and management collide. In a crisis, the collision is more likely. As a firm expands beyond the entrepreneurial stage, so does the control system. Buraway (1979) adds that there is an element of spontaneous consent combined with coercion in an organization. He goes on to suggest that there is a need to place the workers' consent in the context of social control.

Thompson (1983) adds that control varies in dimension. Control implies a hierarchy, even in circumstances of "responsible autonomy" or empowerment. In these cases, the immediacy of the market replaces direct supervision, and the links to the chain of command are re-arranged or obscured. They are, however, still there. The degree of worker discretion is subject to the dictates of the purposes of the enterprise.

In addition, the hierarchy exists because the purpose is to be profitable. The dictates of accumulation require control. He goes on to say that it is difficult to integrate consent into capitalist labour practices. He also argues that the problem is in the nature of consent itself. A more appropriate term suggested in "compliance." The workers give compliance rather than consent.

Empowerment under these circumstances means that workers have input into how these requirements can be met or exceeded. It becomes an issue of minimum compliance. Mundel (1992) discusses this from the standpoint of Japanese production systems. There are minimum production requirements which have to be met. If the production is not up to specification, the workers may shut down the process. This does not mean lost production, as the products would be rejected anyway. Workers are empowered to correct a known problem right away.

O'Reilly (1989) discusses the issue of motivation in an organization with a view to greater employee participation, and uses the Unitarian Church as an example of how cults indoctrinate new members. Manipulation as a means of control is documented in sociological literature (Durkheim, 1961; Mead, 1934; Berger, 1964). Adler (1993) implies the use of fear in his description of the NUMMI plant. In the NUMMI case workers had previously been laid off in a plant closure, and faced unemployment for some time. Adler implied that this could affect their view towards their new employer. This is a more sophisticated application of concepts described by

Henry (1963) and Berger (1964). These are subtle applications of manipulation.

Another factor which suggests an illusory view of empowerment is the current trend in "re-engineering." In this case, employees who have been "empowered" may later find themselves gone (Hammer. 1993).

Ackoff (1981) proposes a system in which employees are empowered through a board structure, but constrained by operating in a profit center mode, except in proprietary services, which operate as cost centres. Here, components of the organization are again empowered to meet or exceed some externally determined standard. If they are unable, they must generate their own revenue or face elimination. In these instances, the empowerment is limited and perhaps illusory.

3.6 Cultural Constraints: General

A review of concepts developed by well known twentieth century sociologists does not give much support to the idea of empowering employees as an effective means of achieving organizational goals. The evidence against is at three levels. The first is at the broad cultural level. The second is at the organizational level in a cultural context. The last is at the level of the individual organization. The ideas and concepts described follow the authors named.

At the cultural level, we find some broad general views which do not favour empowering employees to set targets. These are primarily in the area of motivation of the individual in a social setting. Berger (1964) states that a person is born into a social system and is coerced into meeting its demands. Problems of allocation exist, and the means of allocation must protect the system. The problem then is to make certain that people do as they are told.

Packard (1957) touches on the problems of competition with his research in the area of advertising. He suggests that advertising creates differences where none exist, keeping alive companies who have no utilitarian basis for survival. In the current context, we have a paradox. We are striving for productivity, efficiency, value-added and quality in the allocation of resources when our whole system is based on waste through generating perceived diversity.

Our culture is described as an evolution of the protestant work ethic. Max Weber (1930) outlined how making money takes on the character of "purpose" and that capitalism is a moral prescription, widely binding on all members of society to advance their material interests. This was an offshoot of the protestant work ethic, which later went on to challenge that ethic, and arguably supplant it. The challenge came from the development of the large bureaucratic organization. In this setting, power becomes an objective of members of the organization.

Bureaucracy depends on the relationship between formal regulations and a set of offices. The individual is less important than the office or position he/she holds. This enables continuity for the organization, and less reliance on specific individuals. Bureaucratic organizations are established and grow to control those in the organization. The nature of capitalism therefore is to broaden the sphere of control in the attempt to gain material wealth. Empowerment works against the bureaucratic organization in that power and control become less clearly defined. Since members of the organization strive for power over others, the organization will naturally and automatically resist. This is because one's gain in power and control correspond to another's loss.

3.7 Cultural Constraints: The Organizational Interface

Several leading social thinkers have comments on the interface between society and the organization. At this level, the prevailing external views influence the issues surrounding belonging to a specific organization. White (1959) says that we have a competitive psychological nature because we live in a competitive culture. Mead (1934) says that the individual and society are welded together, integral parts of a common process of development. Jules Henry (1963) outlines that society is driven by greed and fear, and that maturity in western culture is the ability to misrepresent while being able to avoid the misrepresentations of others. Merton (1957) states that the emphasis on goals has become increasingly separated from the means for reaching goals, in effect saying that the ends justify the means.

In schools, we have a de-emphasis on content and values and an increased emphasis on democratization of social relationships (Reisman, 1961). What a child learns is not as important as developing a capacity to get along with others. He goes on to say that we are moving from a dedication to morality to a promotion of morale.

C. Wright Mills (1956) goes on to add that people derive power from an institutionalized base, and that status panic exists among white collar workers. In this context, prestige does not come from the value of the work performed, but rather from the capacity to identify with some source that does have recognition. This has manifested itself significantly in the area of education. We see that educational requirements for jobs have been rising, but the actual requirements for performing the tasks is declining. Thus, the difference between the hope education offers and what it brings is broadening. This causes a growing discontent and frustration among white collar workers. There is also a flood of young people with high hopes.

In this environment, people are losers and don't know it - they are controlled and manipulated. Status claims become more perilous and unrealistic. Mills reaches the conclusion that the psychological strains cause a desire for more authoritarianism in organizations, thus a resistance to empowerment.

3.8 Cultural Constraints: Within The Organization

Many of these social characteristics also impact at the organizational level, reducing the ability of management to trust the workers on the one hand, and reducing the trustworthiness of management on the other. There are additional reasons why empowering may not be a generally useful method at the organizational level. Aside from moral issues, Garfinkel (1967) points out that people are unreliable as receptors. Empowerment requires alignment with corporate goals and direction, and often requires significant amounts of training. If people base the validity of information on what makes sense to them rather than the actual factors on which it is based, as Garfinkel suggests, problems will naturally arise.

Becker (1963) addresses the problem associated with the differences in people. He indicates that classifying people is difficult at best due to variances. There are tremendous problems in labelling people. This poses problems at two levels: societal and organizational. Empowerment may require a certain type or group of types to be successful. Successful empowerment requires certain environmental conditions and behavioral requirements (Covey, 1991), thus it may only be applicable to a limited segment of people, not generally applicable.

If a firm wishes to use empowerment based processes, they need the types of people who are adapted to those processes and systems. In this instance, success in staffing is problematic in that people can not be classified that easily. At the societal level, it may not be reasonable to assume that all organizations can staff with the right types of people. Since people cover a spectrum, not all organizations can have the "right" people for empowerment programs. Their management systems have to allow for this in their operations

The most compelling arguments center around the issues of trust and control. Mills (1956) shows that there is a need for control, as white collar workers are frustrated. Sorokin (1941) deals with ethics in the context of social cycles. In a sensate culture, ethics are relative, and circumstantial, geared to reaching happiness. Economic wealth is for pleasure. Merton (1957) supports this with the notion of means justifying the ends. While some firms may be able to staff with the right kind of people, society in general is not composed of people who can be trusted with empowerment. Durkheim (1951) shows that the price of individualism may be anxiety and death. Reisman (1961) and Berger (1964) discuss the fear of ostracism as a control agent. Counting on individual effort in an organization may not be realistic, especially if it results in pressure from peers. Goffman's (1959) description of symptomatic behaviour, where style can be more important than substance, casts doubt on the reliability of information communicated. Finally, Henry (1963) introduces the concept of the fear of failure leading to dishonest behaviour.

Emile Durkheim (1951, 1961) indicates that moral order is directly related to social structure. He also indicates that in a social structure, there can be no success without failure. This is the win-lose notion. The inseparability of the individual from society in the light of the nature of society is the problem here. While there are cases where the right kind of people exist for implementing empowerment type systems, in general, this can not be an across the board affair, and management must realize this in its actions. To generally apply methods which require a type of person or organizational makeup which doesn't exist would not be proper.

3.9 Summary of Social Factors

In closing, reviewing accepted sociological thought paints a grim view for general application of empowerment in an organization. It suggests that in effect, we are for the most part being manipulated and controlled, and direct, authoritarian control may be more honest than so called "empowerment" methods. Ironically, Duncan (1962) outlined that the use of money as communication, which in turn influences the communication process, is responsible for much of the impetus to quantify the unquantifiable, leading to labelling and compartmentalizing of people for use in systems.

We may not be culturally prepared for general application of empowerment based systems, or for arbitrarily placing people in them. White (1959) makes the statement "invention is the mother of necessity." He goes on to explain that an invention or innovation will not come into being until the cultural base is sufficiently developed. When a cultural base has developed to a point it is capable of supporting an innovation, it will happen. The difficulties in adoption and implementation of new management systems could be because the culture of society is not ready for them.

3.10 Related Trends In Management Literature

Global competitiveness is an accepted issue facing firms. Global competitiveness is listed as a condition for survival, with fast response time a key ingredient (Noori, 1993). Much of the literature favours empowerment of some type. Senge (1990), Covey (1991) and Kanter (1989) all propose systems which place more responsibility and decision making on individuals. As an ideal, it has great merit. In the practical sense, more autocratic methods may be of more use. The focus of the literature seems to be on larger firms.

Statistics Canada[5] data show that approximately 80% of workers are employed by small firms. Much of management literature seems to focus on large firms, so small firm effects are undetermined.

In the face of the disappointing results of TQM (Ernst & Young, 1992) and the sociological evidence, empowerment based systems may be most successfully applied in specific cases in which the economic conditions of the firm and the particular characteristics of the employees favour it. In some cases, the proper conditions may be able to be developed by management, but in other cases, they may not. This has not been developed in the literature reviewed. This is alluded to by Noori (1993) who comments on the need to manage different cultural groups and minorities. In the sociological context, all people are somewhat different, and are difficult if not impossible to categorize (Becker, 1963). Hayes (1994) suggests that generic approaches are not successful, and that strategies have to favour the strengths of an organization, and that similar approaches will yield different results in different firms. This supports the idea (in the absence of hard data) that empowerment may not be generally applicable.

Schaffer authored articles entitled "Successful Change Programs Begin with Results" (1992) and "Demand Better Results and Get them" (1974). These papers discuss how to generate breakthroughs. In a similar vein, Frey (1993) describes a company close to failure which had to force change on its employees. He commented that the people who change the fastest are those who have no choice. Nohria (1994) cautioned against adoption of trendy management techniques. Off the shelf programs do not give the desired results, with 75 of 100 companies unhappy with results. The article also comments on the poor results described in the Ernst & Young report. Adler (1994) related a case of using older, more autocratic methods with a new twist in the NUMMI plant.

Heitman (1993) comments on the fact that most corporate restructuring is forced. The focus on global competitiveness implies that this may be an ongoing concern. This is consistent with the Business Week article by Byrne (1994) which shows permanent layoffs have stabilized at an average of 3100 per day from existing firms. The re-engineering (Hammer, 1993) has taken on such form as "don't automate, obliterate" which threatens worker security. The re-engineering, restructuring movement is in conflict with objectives of systems such as TQM which strive to maintain workforce levels. This conflict was discussed in the cultural context by Whittaker (1993).

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[5] Economic Development Edmonton reference files

A neutral article relative to the autocratic vs. empowered management styles was published by Higgenson (1993). Management style was not as important as the consistency of management. This is supported by Covey (1991) who outlined the need for trustworthiness. Duck (1993) added that it is difficult to maintain trust in critical times such as when downsizing. She also mentions that management cannot guarantee job security in the current economic environment, with workers finding themselves on the bottom step of Maslow's hierarchy. A significant comment relative to concepts contained herein is that team performance is as much a factor of employees as management.

In the against column, Allender (1993) comments on the failings of self directed teams. A major problem is continual cascading of training whereby training keeps getting driven into lower and lower levels. Training becomes a costly problem in terms of time, money and scheduling. It may actually hurt productivity in certain cases. He comments that an organization in distress cannot afford the extensive investment in training and education without immediate payback: training should only be used to address specific needs which are immediate and known, not used as a general cure. It is also stated by Allender that managers need to be doing their job and improving the business, not dedicating themselves to the time consuming cascade training exercise.

Marlow (1991) addresses the problem from the perspective of Management by Objectives (MBO). In his review of MBO and its effectiveness, he supports much of the accepted sociological theory. MBO has not delivered the string of success stories expected by theorists and managers. The lack of success is due to the fundamental difficulties in managing both management and employee expectations. Elements of MBO were used as early as the 1920's, with 75% of firms surveyed in 1980 stating that they used MBO.

MBO sees employees and managers agreeing on employee goals, setting measures and monitoring progress. While employee involvement is expected to improve performance, Marlow's examination of articles assessing the effectiveness of MBO is discouraging. The more rigorous the study, the more likely that MBO is not effective. The effects, if any, tend to disappear after 6-9 months.

MBO tends to ignore the personal objectives of the individual. Objectives set by employees tend to be those which they feel are most easily achieved. They tend to negotiate goals which maximize their opportunity for reward. This is again consistent with established sociological thought.

Pearson (1992) discusses how firms implementing corrective programs often fail. The reason is primarily due to the fact that they are all doing the same things which do not work well. He sums it up by stating:

> "Today, global US companies in nearly every major industry find themselves tormented in a competitive purgatory largely of their own making."

He goes on to say that all suffer from the "7 Deadly Sins" of:

- Inconsistent product quality.
- Slow response to the market place.
- Lack of innovative and competitive products.
- Uncompetitive cost structure.
- Inadequate employee involvement.
- Unresponsive customer service.
- Inefficient resource allocation.

These "sins" are pervasive, management induced and directed. Nobody noticed the company falling behind until deeply entrenched operating problems have become visible, serious vulnerabilities. The reason for a company ending up in this situation is that the organization continues to do what it is good at - those things which made it successful in the first place.

To deal with the problem, top managers are installing corrective programs. They shift the emphasis to innovation and reallocate resources to core business areas - things that they presumably do best. They focus on operational improvements in quality, customer responsiveness and cost. These remedies fail to deliver - the improvements do not hold because other organizations are doing the same things.

The basic reason for failure is that organizations do not address the root cause: negative, risk averse bureaucratic work environments. Pearson goes on to say that managers have to reinvent the organization, to create a work environment that stresses speed, Spartanism, innovation and a market focus. As Woolsey (1981) commented on F.W. Taylor's work, the employees need to believe that management is doing 50% of the work.

Pearson uses Komatsu as an example. They set a target to be 30% lower cost than Caterpillar. Significantly, his prescription for success contains items which smacks of autocratic management:

- Decide what the firm stands for that is competitive and significant
- Set, enforce and raise higher competitive performance standards
- Create a reward system that emphasizes performance

This is not isolated. Katzenbach (1993) lists important factors for getting the most out of teams. Some of these are autocratic in nature:

- Establish urgency, demanding performance standards and direction
- Set clear rules of behaviour
- Set and seize upon a few immediate performance tasks and goals

Specific goals are required to focus a team. Management sets the goals which allow the teams to "win." This approach aligns with Ackoff's (1980) model where management brings a default plan to the table. It also fits well with Schaffer (1992) who stresses that management needs to demand results. Katzenbach also stresses that effective teams require individuals who are willing to be accountable for their behaviours.

3.11 No Clear Answer to Empowerment vs. Autocracy

The team building concepts, those favouring empowerment and cultural development and those in the area of TQM tend to focus on giving more autonomy to the workers in an organization. Senge (1990) has pointed out that a team with individual IQ's of 120 have an average team IQ of 87. This is due to lack of alignment of purpose. Successful cases of empowerment have first addressed the alignment issue. Except in survival cases, empowerment seems to be used more for incremental improvements of existing operations, rather that wholesale changes. Research focused on immediate competitiveness issues and re-engineering have more of a control focus. Both types are suggested as means to improve the competitive position of the U.S. economy. The two approaches do not seem too compatible, but also may not apply to firms in the same situation.

Empowerment has been shown to work in some cases, with good results. It also seems to be a factor of the state of the firm, management capability and the type of employees to which it is applied (Usilander, 1993). Autocratic management is the default position, generally maligned by team and empowerment focused literature. It must be remembered that management strives to get the results it wants and selects strategies to get those results from the workers. Society is composed of differing types of workers though, and it is reasonable to assume that one method may not work for all types (Hayes, 1994). Our culture generally may not be ready for general application these new methods. The best evidence is that they are not having any great impact at this time (White, 1959).

Another important consideration is that even in cases where these more democratic systems work, they may require people of certain personality and skill characteristics. While some firms may be able to staff with these people, all can't. Management must then be able to adapt to get the most out of employees outside of this spectrum. It might be that it is the role of management to adapt to the culture of the workers, rather than forcing the workers to conform to a new culture.

The realities of competition require management to keep the organization alive and growing. Hammer (1993) suggests that firms are apt to face crises, and that the crisis conditions are here to stay. Management is responsible for the whole production system, and has to introduce measures to improve the system's performance or to redesign the system for better performance. The price paid by workers for being in the employ of another is that they do not have a great deal of say in the matter. Ultimately, they rely on the abilities of management and owners to provide the right system. That is not their responsibility. In the case of efficient systems in competitive markets, the system improvements will eventually come through large scale change rather than incremental improvements. We are seeing the beginning of this with the consistent permanent layoff figures.

In this environment, management is charged with the task of setting performance targets within given processes and in determining wholesale system redesigns. Productivity is becoming the foundation for creating competitive advantage (Rappaport, 1992) with response time becoming ever more critical (Stalk, 1989). Workers will be increasingly focused on their production duties. Manufacturing is leading in this respect, with dramatic increases in productivity realized over the last few years (Roach, 1991). The competition is akin to a war, and fast response is everything. For some firms, empowerment based systems will be the appropriate means for facing the realities of a highly competitive world. For those firms who do not have the time and resources to survive long enough or are unable to attract or develop the right type of people for an effective empowerment based system, more authoritarian means may need to be used.

Research indicates that successful application of empowerment is constrained and is a case of degree to suit the situation (Hirshhorn, 1992). It is also not likely just a function of management expertise and corporate culture, but depends on the overall societal culture and social nature of employees who are greatly affected by the overall cultural influence. Empowerment has been demonstrated to be successful in specific cases, but not generally, with the greatest success seeming to come from relatively few applications. This may be due to the combination of factors required for successful application, that is employees, management and the organization likely have to all have certain characteristics, with external factors adding focus to the effort.

The implications for management are interesting. If you can develop or attract the right types of personnel, you may be able to successfully implement an empowerment based system. In this case, management can rely on input from employees in determining systems improvements and performance requirements. If not, a more hands on management approach may be required. Management will then have to set requirements for outputs and determine areas for system improvements.

Successful applications have both breadth and depth (Hall, 1993), so partial applications are not in a high probability of success range. This gives some support to the idea that an organization has to have the right kind of people and culture for successful empowerment. Interestingly, management may have a greater responsibility to understand their employees to determine to what degree empowerment may be applicable. Management will also have to understand its responsibility in generating profitable performance without being able to apply some of the newer methods in the literature.

3.12 Conclusions

In specific instances, empowering employees to assist in the determination of critical systems changes may work. In the general case, there would likely be problems. Empowerment can be used in developing the implementation plans for targets that have been set, but can not be generally expected to be effective in cases of crisis where there is a high probability of significant job loss or dislocation.

There is no clear model for general application in a firm in crisis which shows a high probability of success using empowerment or employee involvement in major change. These changes should be made before undertaking organizational focuses which utilize employee inputs in management decisions. With the right people and preparation, empowerment can be effective, especially in developing process improvements and implementation plans.

Generally, management will have to set the performance requirements for the organization, and will have to set the targets for the system parameters with which the organization will achieve those requirements. In time of crisis, the employees will be looking for solid leadership from management.

The rationale for management taking the lead in setting targets to address crises is best captured by the following quote:

> "product defects, failures and accidents are invariably the result of human error...Since the worker is merely part of the production system, which has been consciously and deliberately designed, it stands to reason that those who designed the system are responsible for any inadequacies occurring in it" (Ayres, 1988).

Since management has the responsibility for the system, it is also their responsibility to propose a system to meet the organization's needs and goals in time of crisis. This means that they must have a method for determining system targets and must use it. The methods proposed in this thesis are also robust in that they can be applied in instances where employee participation is desirable and useful. Ackoff (1980) suggests that even when management wishes consensus with subordinates on a course of action, it must still bring a default position to the table. The targeting procedure can thus be used in both circumstances and thus be generally applicable.

CHAPTER 4: THEORY AND PROPOSITIONS

As mentioned in Chapter 1, the QA group of the University of Alberta Hospitals was the initial site for the research. This chapter draws together the experience and learnings from the research into a process and protocol that can be used for further applications.

There were key factors which needed to be addressed in the development of process and application protocol. The two were inter-related through the development of the targeting procedure, with several of the learnings from the exploratory research leading to addition and change of components of the process. In addition, a protocol was needed for consistency in further applications to provide a better basis for comparing results and measuring against the initial theory and propositions.

Developing and testing the targeting process using input from hospital QA staff provided a partial validation of the necessary condition of senior management participation and commitment as a requirement for success. The exploratory work at the University of Alberta Hospitals illustrated that without this support, there would not likely be successful results.

Many of the delays in obtaining data and information reflected the minimal support for the procedure. There was initial enthusiasm from Mr. Altopedi, who was in charge of implementing the TQM system at the University of Alberta Hospitals. He was subsequently replaced. Mr. Taras Diduck, working under a new manager, Ms. Judy Wry, provided some support. A presentation at a senior management team meeting in June 1990 saw the proposal referred back to QA personnel for limited support. Information gathering and employee surveys became difficult to schedule under these conditions. In an actual application, this would be a fatal problem.

In the exploratory research, limited information relating to doctors' performance was made available for study of the process improvement step. This was highly sensitive information, so only a small sample was provided for illustrative purposes. It was felt that since this was an exploratory case and that the process improvement step was not a key to the contribution that a small sample would suffice for illustrative purposes.

Further applications for implementation would require significant samples for process data. Analysis of the small sample illustrated potential problems in using limited data for process improvement purposes. This analysis indicated that further application of the process improvement methods should utilize more complete data sets.

The delays caused by these actions illustrated the importance of senior level involvement. The process was exacerbated by the wholesale changes over the ensuing years. These changes saw the elimination of the QA office, changes in key staff, changes to the organization, dropping of CMG's and the introduction of a new control structure.

A key requirement for additional applications became the commitment of management to carry the process through. This became a reporting point in the development of the protocol for further application. Since the time to implement the process would be of importance in addressing a real crisis, the times for each stage needed to be recorded. Resource requirements are also of interest, as relative cost and management time would be important considerations. While the researcher would be the key resource person, other key people would be needed to complete the process. It would then be necessary to identify who these people should be for each stage.

The hospital exploration combined with additional research indicated an order to the underlying theoretical basis which naturally suggests process steps which in turn led to the completion of the process and protocol.

Conventional methods for addressing crises quickly focus on cost reduction. This places an initial constraint on the process of developing solutions. In this context, the customers and the overall goals of the organization tend to get set aside while cost related issues are resolved.

4.1 Prevailing Circumstances

Prior to beginning formal steps to establish the context for analysis, it is useful to understand the internal and external circumstances which can have a significant effect on the outcome of developing productivity improvement targets. This information is useful in analyzing the effectiveness of the targeting procedure and its inherent propositions and theories.

The external factors relate to overall conditions in both the economy and the particular sector of the organization. Internal factors relate to the willingness and ability of management to develop and implement change, as well as the organization's ability or willingness to accept change. The role of management in the process is a critical circumstantial factor.

It has been established in Chapter 3 that there are conditions in which management must take the lead in determining changes to insure the health of an organization. Under crisis conditions, it may be counter-productive to attempt to utilize worker input when re-designing a system. As Covey points out, without the potential for a win-win outcome, various empowerment based methods will not likely work. On the other hand, there are proven interactive methods for systems design and planning which have been developed by Ackoff and Nadler. A means of bridging the gap of no potential win-win is required to enable application of these methods.

In cases where conditions for empowerment may not initially exist, and thus methods for change based on empowerment may fail, the focus shifts to how can conditions be created to generate the possibility for a win-win. In a crisis, changes can result in salary reduction, job loss, extra work, and loss of advancement opportunities. To expect workers to help make this happen is not reasonable and will probably result in failure. In these cases, management needs to either determine the changes to be made to the organization, or develop a means to change the "state-of-the-world" such that workers have the potential to improve the situation. The "state-of-the-world" in this context refers to the conditions faced by the workers.

An example of this is the Xerox wiring harness case where the workers were given the choice of finding a greatly reduced cost alternative or have the plant closed (Foote-White, 1991). The workers, under these circumstances, were able to find a workable alternative.

In theory, this concept allows for a forced change in circumstances to create an opportunity for successful empowerment which in turn allows for use of established techniques which rely on interactive inputs from employees. This approach also is consistent with Ackoff's Corporate Democracy model which requires management to bring a default position to the table. This default position is to be utilized when employees do not reach consensus on an alternative preferable to them.

Nadler's Planning and Design Approach also requires the development of technically feasible alternatives from which implementation plans are developed. In this case, the management target becomes a benchmark case. The interactive planning can still occur to improve on or provide alternatives to this case.

4.2 Establish the Context for Analysis

The integration of the concepts of TQM, Nadler, Goldratt, Ackoff and Schaffer result in the establishment of the context for determining potential "targets" for change. After the overall circumstances of management's position, the organization's willingness to accept change and the economic environment of the sector are determined, there are four steps to establishing the context:

1. Determine the "Purpose" of the Organization
2. Identify Customers and Stakeholders
3. State the Goals of the Organization
4. Specify Objectives and Performance Measures.

This provides a context for analysis which has fewer initial constraints. This alternative approach to setting the "context" is illustrated by the exploratory research in hospital care, where the context did not seem apparent.

Determine the "Purpose" of the Organization

Nadler (1990) suggests that every good design process begins by establishing the overall purpose. This step puts important perspective on the crisis. For example, if a firm is in financial difficulty while nearing the end of its expected life, the approach may be different than a start-up company. Many firms have such statements in place.

Should there be a need to develop a purpose statement, Nadler also provides a process for establishing the "purpose" of an organization. It is important to keep in mind why the organization exists and what it is trying to achieve. This process is described in detail in the "Planning and Design Approach" (Nadler, 1990). Nadler's process for the development of a purpose statement requires some arbitrary decisions based on the values and principles of management.

Nadler uses brainstorming to generate a list of possible purpose statements. A low level purpose is selected from the list and then expanded. He suggests that it is useful to choose a small scope purpose as a beginning and then expand into a hierarchy, and then select a functional level for the overall purpose. The listing should go beyond the visualized immediate requirements associated with the crisis to longer range issues. This will help focus the targeting process on the overall system rather than the immediate problems at hand. It will also allow design at the highest level practical under the crisis conditions.

Identify Customers and Stakeholders

TQM (Juran, 1988) maintains a strong customer focus. The purpose is to improve both quality and productivity in ways which meet the customer's needs. The approach considers internal customers and other "stakeholders" such as owners and shareholders as important to consider as well (Deming, 1980). Feigenbaum (1983) provides a useful definition of "customer" which is utilized in this research: the customer is the one who pays. This is an important distinction. In some cases, it is not clear who the customer really is. For example, many hospitals, including local ones (Gopalakrishnan, 1992) consider patients as the primary customer, even though they are a very minor source of revenues. There are also considerations based on the philosophy and values of the organization. The organization may have selected a market segment or customer group as its desired customer base. There may also be operational constraints restricting the customer base.

Key stakeholders are identified and listed next. A "Stakeholder" is defined as follows: a "Stakeholder" has direct impact on costs. Stakeholder identification gives a clear indication as to who owns what in the process. Because stakeholders influence costs, they should be identified as they will play a role in activity based analysis used in subsequent steps. Knowledge of key stakeholders may be useful in the implementation planning.

State the Goals of the Organization

Prior to placing any firm objectives and measurable results, goals should be stated. TQM applications see a lot of effort placed in development of vision, mission, core values and guiding principles. These are very closely related to goals, as they reflect on how an organization would prefer to meets its objectives and realize its purpose.

The goals of the organization are arbitrary in nature and reflect the desires and values of the owners and management. These are consistent with the purpose, but are more general than the specific objectives and performance results.

The goals should address expected future requirements as well to avoid short term fixes which only deal with the immediate concerns. Trying to anticipate possible future crises or challenges while dealing with the current one can enable prevention and/or avoidance of future crises. The objective of this step is to help prevent negative effects from system redesign and to improve the potential for longer term positive outcomes.

Adopting a view to the future in anticipating productivity requirements for the health of the organization is also in alignment with the "goal" of the organization (Goldratt, 1984).

Objectives and Performance Measures

Schaffer stated that "successful change programs begin with results." The reason for specifying results is to create a focus on the required outcome of a system change. Results become a constraint for success. Failure to develop an alternative which meets the objective indicates that the organization may be beyond saving. This is an important measure to meet.

Thus, the last step in establishing the context for change is to clearly outline what objectives (outcomes) are desired or required in terms of performance improvements. Actions should be based on achieving a purpose.

This relates the concepts of Schaffer (1987), Nadler (1990), Goldratt (1984) and Ackoff (1980) to the process of establishing targets for productivity improvements. The procedure should be driven by a purpose, with the objectives clearly stated in advance.

The specification of objectives, in keeping with the overall theme of the previous sections is not constraining as to how results are achieved. Again, this is an alternative approach to traditional methods which constrain efforts to cost reduction or some variant thereof. The establishment of objectives ties Schaffer's concepts to Ackoff's "ends planning" and Nadler's "purposes principle." The results needed are the major constraint to the targeting process.

The objectives will reflect some external condition related to the crisis. For example, an organization may have financial commitments which must be met by a specified time. There may also be a perceived threat such as lost business which can generate a crisis. A determination is made as to what must be achieved to reduce or eliminate the external threat.

The performance results will be derived from the objectives, while the re-design process will be constrained by the purpose and objectives. The level of improvement in productivity should be clearly stated in simple terms. The objective could be in terms of a percentage, dollar value in terms of total cost per unit or in terms of a dollar value for a given level of throughput. The level of improvement should be a significant change from existing levels (Schaffer, 1992). This will focus targeting efforts on major change rather than on incremental improvements.

The performance measures should be simple: what was the actual target performance and did the target meet the requirements of the objectives, yes or no? This reduces the potential for subjective distortion of whether the objectives have been met.

4.3 Prioritization of the Sub-systems for Analysis

The next series of steps result in the determination of the organization's priority sub-system, which will be the area for initial analysis. The initial research in the hospital environment indicated a problem in clearly identifying where to begin any major change program, leading to the development of this stage in the process. In this stage, the overall system is decomposed into major sub-systems, followed by the identification of the crucial one for analysis.

With the context for analysis in place, the question becomes where to begin the analysis to determine potential changes which meet the objectives. Conventional methods focus on cost, but do not systematically determine priority areas for analysis. Goldratt's methods, used to increase production to meet excess demand, place priority on units of output, since that is what creates revenues. The normal application of these methods is at the process level, but the concept is expanded to consider sub-systems. Integrating Goldratt's concept of priority with Quality Function Deployment (QFD) matrix methods provides a systematic means of prioritizing sub-systems for analysis.

The QFD matrix methods tie the customer through to inputs and can be adapted to any level of detail. Traditional use of this technique is as a design tool in product development to maintain a linkage between the customer's needs and all aspects of the production process. Because this method also considers interactions, which is consistent with Ackoff and Nadler's systems concepts, it is adapted here for use as a prioritization tool. Rather than link various design criteria, it is used to establish relative priority of the sub-systems in an organization. Integration of QFD and Goldratt's costing concepts provides the means to establish priority with this tool by linking the revenue through to resources and processes, while considering interactive effects.

The process for determining the priority sub-system for analysis is key to the method. Development of the theoretical basis provides a logical series of steps:

1. Establish the Basis for Priority
2. Prioritize the Sub-systems
3. Gather System Data and Confirm the Priority Area
4. Flow Chart the "Core Production Sub-system"

Establish the Basis for Priority

Goldratt suggests that the highest priority is revenue which is generated by units of output. Using this basis for priority, the constraints on developing productivity improvements in crisis are reduced by introducing the option of increasing revenues as well as reducing costs. It also provides a basis for establishing relative priorities within a given operating system.

The first step in the prioritization process is to determine what the key revenue generating outputs are, and what major sub-systems generate these outputs. This determination is then represented in a simple systems diagram which focuses attention on those components. The question to be answered is: What key product or products generate(s) revenues? This operation is represented by a black box defined in terms of inputs and outputs. A representation is shown in Figure 4.1.

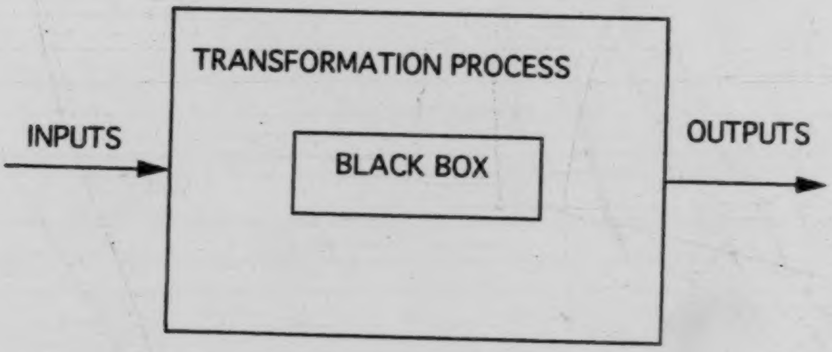


Figure 4.1: The "Black Box" Transformation Process

Sub-systems which provide inputs to the above black box are added. The convention used here is to show the flow to fill output orders or sales on a horizontal line flowing from left to right, with support services and other sub-systems shown with vertical connections. Non-productive functions such as administration may be shown as not connected if the relationship to throughput is weak or non-existent.

The result of this exercise is a diagram which will be called a "systems diagram."

Prioritize the Sub-systems

When the key output has been identified along with the major contributing sub-systems, the process of prioritizing the various sub-systems for analysis may begin. This step both prioritizes the various sub-systems and eliminates areas of low priority from consideration. This serves to focus attention on those areas which, when changed, will make the greatest contribution to improvement. An adaptation of QFD matrices is used.

Three matrices are developed which connect: the customer to key output characteristics; key output characteristics to sub-systems; sub-systems to resources. The reason for tracing the connection is to determine the link-to-revenue. That is, what output characteristics are most connected with the customers willingness to pay, which sub-systems are most directly connected to those output characteristics and finally, which resources are most directly connected to those sub-systems. This identifies the linkage from revenues to resources and enables prioritization through the system. It also allows for the removal of several characteristics and sub-systems from immediate consideration. Those without direct connections are dropped. Priority is based on direct linkages through to revenue. The matrix development is highlighted in Figure 4.2.

The first matrix, linking customers to key output characteristics, is constructed as follows:

The customers are listed down the left hand column, the output characteristics across the top. A solid dot is used to show direct linkage between what the customer wants to pay for and the respective characteristics. This is the only relationship which is considered in this matrix.

The second matrix shows the relation between the key output characteristics and the organization's sub-systems. The key output characteristics from the first matrix are placed in the left hand column, and the sub-system list is added along the top. The linkage between the key output characteristics and the relevant sub-systems is shown as:

- "Direct" (solid dot) if there would be no product without this sub-system.
- "Indirect" (circle) to indicate support to operations, for example maintenance or supplies.
- "None" (no character) to show no direct or indirect linkage.

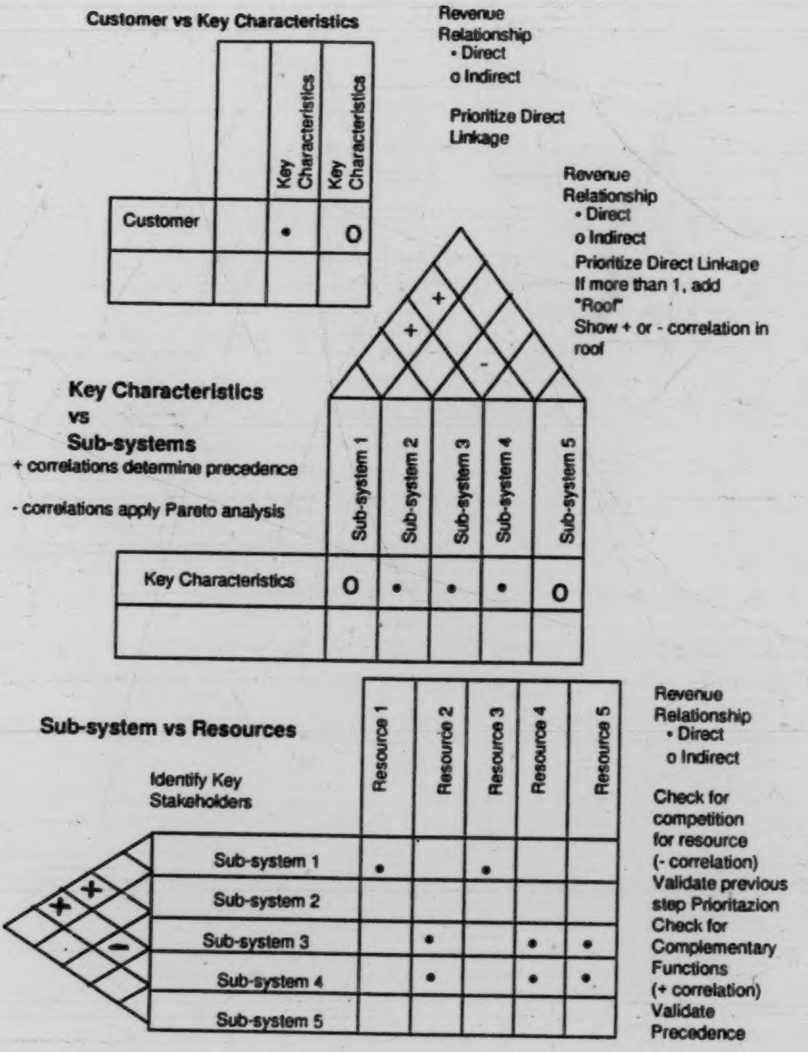


Figure 4.2: The Utilization of QFD in Developing Prioritization Rules

When there is more than one direct linkage, a "roof" is added to the matrix to check correlations between the sub-systems. A strong positive correlation is shown with a "+" while strong negative correlations are shown with a "-". Blank means no or slight correlation.

Examine the positively correlated sub-systems for precedence relationships to determine which provide support or assistance in creating product and which directly create the product.

Negatively correlated sub-systems compete for some of the same resources. Because of this, among the negatively correlated sub-systems the one with the largest contribution to revenues is given the highest priority.

The third matrix identifies the linkage between the priority sub-systems and the resources utilized in creating product. The sub-systems are listed in the left hand column, and the resources are added along the top.

- Direct linkages (solid dot) indicate a direct contribution of the resource to a particular sub-system. These represent the critical resources required to create a unit of product.
- Indirect linkages (circle) indicate resources which provide support to product generation but do not directly create the product.

The three matrices and the application rules are shown in Figure 4.2.

Gather System Data and Confirm the Priority Area

The final confirmation of the key area for initial analysis may require gathering of broad based systems data to complete the prioritization process.

The data that will give an overall picture of the total production throughput for all the critical sub-systems will be used to rank the high priority sub-systems in the event there are more than one directly linked to revenues. The highest ranked priority sub-system will be termed the "Core Production Sub-system." The data also shows the baseline cost and revenue data for the overall system. Generally this data, because it is basically macro data, can be found in the budget or summary accounts of the unit.

Flow Chart the "Core Production Sub-system"

The final step after identifying the "core production system", which is the initial candidate for analysis, is to draw a diagrammatic representation of that system, showing key inputs. This provides a focus as to where the initial efforts will be placed. Subsequent stages and steps will utilize some of the information, and build on it.

A suggested means of developing this diagram is to use a precedence diagram with "activities on node."

4.4 Core Production Sub-system Redesign

Once the critical step of identifying the priority area for consideration has been completed, the question becomes "what is the strategy for proceeding?" Covey has stated "first do the right things, then do things right." This places priority on making broad based system and process changes first, then improve those processes which are retained. This is consistent with Ackoff and Nadler, and forms the basis for the strategy of developing alternatives. This is in contrast to established crisis management approaches which focus on existing processes for change. Re-engineering also has a process focus rather than a broader system focus for initiating changes.

The means to develop these alternatives is developed by adapting and integrating established TQM and Industrial Engineering methods, ABC costing methods, and Goldratt's concept of separation of activities.

The resulting approach offers a unique adaptation of ABC costing for use as a re-design tool rather than a tool for allocating overhead costs. Combining these propositions results in a logical series of process steps:

1. Draw a critical activities matrix.
2. Gather activity times.
3. Separate activities.
4. Develop alternatives.

Establish the Critical Activities Matrix

The core production system is now separated into a series of critical activities necessary for the operation of the system. ABC costing concepts indicate that activity times can be used to allocate overhead costs based on relative resource activity time requirements for given levels of production. This concept is extended to provide an estimate of resource costs.

The extension is achieved by determining relative activity times, which is consistent with current ABC application, in conjunction with a relative cost for a particular resource. It becomes critical, in this application, to determine what activities are performed by which resources in the creation of revenue generating outputs. The activities and resources are presented in matrix form.

The critical activities matrix illustrates the key activities required for creating a unit of product. It is necessary to identify the activities and the resources required for each activity. The activity list is obtained by direct observation. Process flow charts are a useful way of recording the activities. To make the matrix: List the resources in the left hand column, the activities across the top. Use an "X" to show which resource is related to which activity.

Completion of the matrix provides an indication as to data required to provide the estimate of relative resource costs and utilizations. This forms the basis for comparison of alternatives which are to be developed. Development of this matrix is illustrated in the exploratory hospital case example in the following chapter.

Data Requirements

With the adaptation of ABC for use as a system re-design tool, representative data is required to provide a proxy for current costs. A proxy for costs based on the activity based concepts could be time to complete tasks, units of throughput, resources required or other non-cost numerical representation of productive events. The data requirements should be consistent with the purpose or desired outcome. Process data can be obtained by surveying and measuring processes as they are being done, rather than relying strictly on historical data. The data acquisition should determine actual activities and place a value on them in terms of time or cost. Major system improvements and changes should be noticeable without detailed data.

For processes and/or resources which are required or cannot be easily changed or replaced, historical data may be required as the potential improvements for these resources may be marginal or incremental.

Data collection should be the responsibility of the person or persons responsible for targeting. Mintzberg (1990) indicates that managers primarily get their information by word of mouth and by direct communication. To obtain representative data for the analysis, managers should, as much as possible, go directly to the source to get first hand information. Direct interview of representative sources is used successfully in product development (Cooper, 1990) and enables a first hand view of what is actually going on as opposed to what is perceived to be happening.

Activity Data

This data covers the activities of the resources in the core production flow chart and critical process matrix. Costs based on activities for existing resources provide a basis for comparison of alternatives. Alternative system designs can be developed using a relative proportion of existing costs based on activities and relative resource costs.

Data is collected based on what is actually happening. The data reflects activities and time consumed for tasks and resources. Considerations for process data are as follows:

- Represent major activities.
- Reflect productivity.
- Real data based on what is actually happening rather than on policy (what is supposed to be happening).
- Reflect resources and activities and their utilizations.
- Based on activity levels.
- The sequences or groups of activities.
- Resource and/or sub-system constraints, if any.
- Bottlenecks - throughput limiters, constraints.
    - Overtime.
    - Breakdowns.
    - Inventory piling up.
    - Fully utilized resources.
- Use care in selecting a measure which will represent the costing concepts while

still being relatively simple and easy to use.

- Strive for a minimum amount of data. Large scale change can be determined without large amounts of detailed data.

Direct linked resources are analogous to machines in a production line. Some are bottlenecks, others have slack time. With machines and facilities it is easy to determine when a resource becomes a bottleneck. When the resources are people this distinction is sometimes difficult because people will usually find alternative tasks and the slack will not be easily observable. Thus, it is necessary to isolate the time each resource spends on the Core Production function, and allocate that time to the identified activities. Time spent on non-core activities is regarded as slack.

Gathering Activity Data

After determining the data requirements for the specific objective, collect data. The best means to collect data which reflects the reality of the organization is to directly survey. General throughput data is available for the overall system, and process activities may be broken down using a sampling method By conducting a direct survey, management has a "hands-on" opportunity to find out what is really going on, and how resources are deployed.

For each resource, determine slack and productive time, and the allocation of producing time to activities. This is determined by direct observation over several cycles.

Separation of Resources/Activities

ABC costing suggests that activities consume resources. Productivity improvement then requires less or lower cost activity per unit of production, or, fewer or lower cost resources per unit of production. Lower cost supplies, for example, can increase the productivity of capital. In short, either less inputs for a given level of production or more output for a given level of inputs.

There are existing Industrial Engineering methods for establishing task and resource comparisons for specific requirements. These tend to be detailed and at a micro level, designed for incremental improvements. TQM and other management methods have a similar focus. A systematic approach is presented for developing alternatives at a broader level requiring limited activity data.

Activities are separated for analysis and development of alternatives. Note that the approach separates activities, not resources. This is important in developing alternatives. Once activity separation is achieved, alternative activities and/or resources can be identified for comparison purposes.

Separate the critical activities in the core production system by splitting them into identifiable components or groups of inseparable components. The components may be resources or activities, or groups of activities.

It may be that some activities cannot be separated. These may be considered as a group. Separation of activities is the first step to change and productivity improvement. Arrow diagrams of the main activities may be used to facilitate separation.

Development of System Alternatives

System alternatives are developed by attempting to obtain the maximum improvement possible within any existing resource constraints. The alternatives developed with this objective may or may not meet or exceed the desired levels. By attempting to get as much improvement as possible, the "purposes after next" principle of Nadler is addressed. Further improvements may be necessary in the future, so it is useful to gain as much as possible now, to help meet future "purposes."

The result also gives an indication of how much room there is for improvement in the short term. If there is no alternative which meets the requirements, management faces one set of decisions. If there is room to spare in meeting the requirements, management has options in developing other alternatives and implementation plans.

For each differentiated activity or sequence of activities, develop a table of alternatives to provide equivalent throughput. In the sequence or group of activities, be aware if any change makes a particular activity unnecessary or redundant. The alternatives may be resources, processes, activities, policies, products, inputs, skill levels or suppliers.

Resources are shown in the left hand column, activities are shown across the top. Management determines, through brainstorming, experience and researching trade related information, what alternatives activities and resources are available, and what their relative cost is as compared to the existing situation. Potential alternative or additional activities are added to the list along the top. Resource alternatives are added to the list on the left.

The "base case" which corresponds to existing resources is shown in the first rows of the matrix. Key information required to complete the matrix are:

- The relative proportional cost of a unit of alternative resource compared to the existing case.
- The time requirement of the alternative resource to complete the activity. This will be represented as an increment added to or subtracted from the base case.

The body of the matrix has the boxes diagonally cut into upper and lower halves. The entries in the matrix body are the proportion of resource time required (upper half of box) and the relative resource cost (lower half). Relative cost comparisons are made down a column. Total relative cost is determined by adding horizontally the best values from each column. This will give the proportion of base costs due to system change.

In this step, explore alternatives which either increase throughput relatively more than costs or reduce costs for the given production level.

4.5 Process Improvements

The final steps, seeking improvements in processes which are carried over and describing the results of the combined steps, are developed here. The only key process which provides a unique application is the adaptation of data ranges as a visual tool for determining cause of variability. The process improvement step is basically a "clean up" step in the process using established concepts. Reporting of results completes the process.

The total variability of the process is comprised of variability common to all and variability between resources or processes. Taguchi (1989) has expanded the concepts of variability to include variability about a desired level, whether a mean, upper or lower bound. This concept is used here. In this application, variability reduction may be in the form of reducing variability from a desired lower limit in terms of time to complete a task.

When variability is between resources, the "best" resource is to be used as a benchmark for the others. Using order statistic concepts (Hogg, 1978), the "best" performing resource is a sufficient estimator or benchmark for achievable performance. In this case, deviation from the "best" performance is to be reduced.

The logical process steps which result from the application of concepts in this chapter are:

1. Determine key remaining processes.
2. Gather process data.
3. Determine cause of variability.
4. Benchmark or variance reduction.

Process Improvements

Continuing with the concept of "doing the right things, then doing things right," the next logical area for consideration are those processes or activities within the core production function which are carried over unchanged. Within the overall scope of the suggested targeting process, only major improvements are sought. At this time the question is "are there processes which have the potential for obvious improvement?"

It has been established in TQM that variance reduction and benchmarking are useful means to improve processes. Choosing which technique to use is contingent on where the source of deviation, or variance from desired lies. The rules used are as follows:

- If the source of variation is between resources, benchmarking is selected.
- If the source of variation is common, or among the resources, variance reduction methods are indicated.

A means of determining the nature of the variability is then required. A useful tool for visually inspecting source of variance has been suggested by Jobson (1988). This method uses simple representation of the ranges for each data source. In this application, it indicates a particular resource/activity combination. This provides an opportunity to determine whether obvious sources of variance exist, and whether they are common or between resources.

Use of this approach reduces the amount of data required, and the amount of skill and equipment required in arriving at conclusions.

Determine Key Remaining Processes

In order to establish process improvement targets for those processes which remain unchanged in the re-designed system, they must first be identified. This step provides that identification. It may be helpful to draw a diagram of the remaining processes to provide focus on what is being examined. The diagram may be of use later in cases where interventions are planned to make changes.

Gather Process Data

Operating process data is required to establish where the variability in the processes is, and whether there is obvious opportunity for improvement. Within the scope of the proposed targeting process, potential for large scale improvement is sought.

Determine Cause of Process Variability

The method suggested by Jobson provides a quick, visual means of determining whether there is large variability and whether it is common or between resources doing the same process. A table or chart which shows the range of the data as well as the mean is the tool to be used. Obvious variabilities will be easily identified by visual inspection.

If the ranges have visually approximate commonality of means, lower and higher extremes, the variability is common. If there is distinct separation between the ranges of different resources, the variability is between resources.

Benchmark or Variance Reduction

If the variability is common, variance reduction is the approach indicated. Should the variability be between resources, benchmarking of the best resource is suggested.

4.6 Articulate the Target

After completion of suggested processes, system change and process improvement targets have been identified. It remains to articulate these in a summary for review and decision making. The results can be compared to the original objectives to see whether there is a feasible alternative.

4.7 Linking the Steps into the Targeting Process

The essence of most crisis intervention techniques is cost reduction. They tend not to seek out value, or contribution, but rather focus on areas of high expenditure to reduce waste and inefficiency. There is little prioritization and all functional areas are regarded as equally vulnerable or valuable.

Application of the concepts, theories and principles of Nadler, Ackoff, Goldratt and ABC costing, using an adaptation of QFD and some standard tools and methods results in a sequence of steps which can be linked into a "Targeting Process." This proposed "Targeting Process" reduces the likelihood of solutions that are counter-productive or self crippling. The process directs the investigation toward those activities or functions that directly influence the revenue-expenditure differential. This allows for a greater variety of solutions, such as revenue enhancement as well as cost reduction.

The targeting approach constrains the order in which system components should be redesigned or changed, without limiting how. Conventional methods constrain efforts to cost reduction, without prioritizing where the changes should occur. The previous four chapters have been developed in a logical order which parallels the targeting process. The targeting process is a representation of the same steps, in the same order, with "stages" comprised of logical groups of steps.

The Targeting Process

The preliminary step in the targeting process is to determine the level of senior management involvement and commitment to proceed. This is a qualifying step which provides an indication of how successful the process can be.

The Targeting Process itself has 4 stages in developing alternatives, with a final stage which summarizes the results. Stage 1 sets the context, Stage 2 prioritizes the sub-systems for analysis, Stage 3 develops system alternatives, Stage 4 identifies process improvements those processes which are to be carried over unchanged into the re-designed system, and Stage 5 is a summary of results.

Stage 1: Establish the Context for Analysis

1. Purpose
2. Customer/Stakeholder Identification
3. Goals
4. Objectives/Performance Measures

Stage 2: Prioritize the Sub-systems

Step 1: Draw a System Diagram
Step 2: Prioritize the Sub-systems
Step 3: Gather System Data
Step 4: Diagram the "Core Production Sub-system"

Stage 3: Core Production Sub-system Redesign

Step 1: Draw the Critical Activities Matrix
Step 2: Gather Activity Times
Step 3: Separate Activities
Step 4: Develop Alternatives

Stage 4: Process Improvements

Step 1: Determine Key Remaining Processes.
Step 2: Gather Process Data.
Step 3: Determine the Cause of Variability.
Step 4: Benchmark or Variance Reduction Methods.

Stage 5: Articulate the Target

Figure 4.3 flow charts the steps in the targeting process.

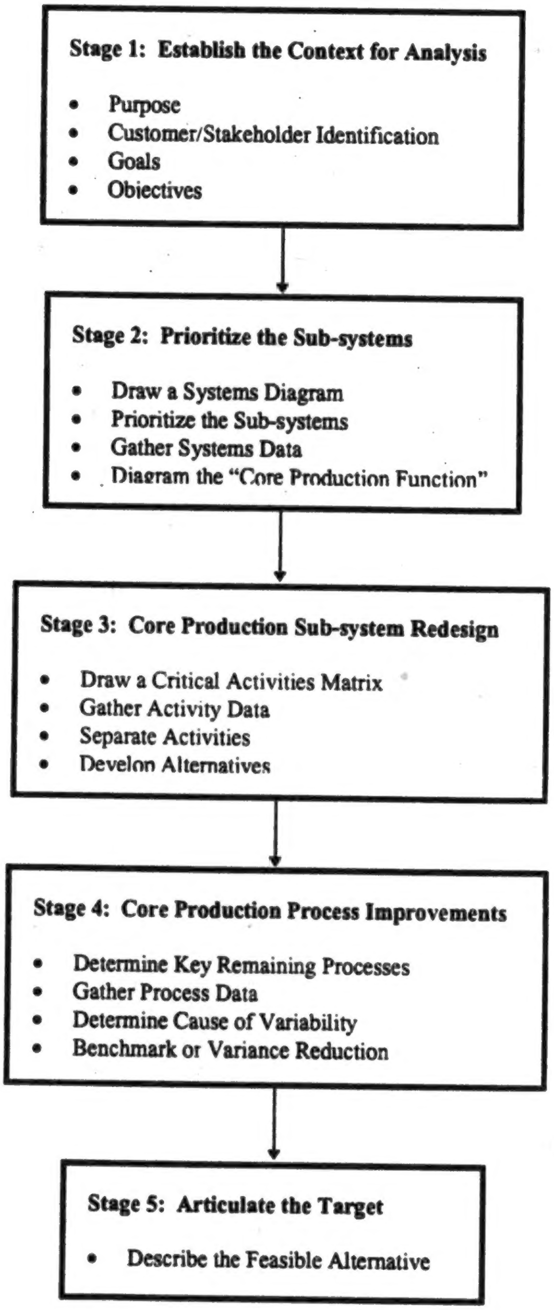

Stage 1: Establish the Context for Analysis
Purpose
Customer/Stakeholder Identification
Goals
Objectives
Stage 2: Prioritize the Sub-systems
Draw a Systems Diagram
Prioritize the Sub-systems
Gather Systems Data
Diagram the "Core Production Function"
Stage 3: Core Production Sub-system Redesign
Draw a Critical Activities Matrix
Gather Activity Data
Separate Activities
Develop Alternatives
Stage 4: Core Production Process Improvements
Determine Key Remaining Processes
Gather Process Data
Determine Cause of Variability
Benchmark or Variance Reduction
Stage 5: Articulate the Target
Describe the Feasible Alternative

Figure 4.3: The "Targeting Process" Flow Chart

4.8 Targeting Process Summary

Integration, adaptation and extension of established systems design methods and TQM methods and tools provides a logical sequence for developing productivity improvement targets in a crisis situation. The resulting process differs from current practices by constraining efforts only in terms of where to begin and what is required. Conventional practices assume a context and establish some variant of cost reduction as the means to achieve change.

The prioritization process, adapted from QFD and Goldratt, provides the unique basis for determining where to begin analysis and redesign activities. Where QFD normally constrains "what" is done, the adapted technique only constrains "where." The basis for priority is revenue generation, as revenues less costs are the critical performance measure, especially in a financial crisis. Goldratt's methods are normally used in cases where production bottlenecks limit ability to fill orders, but are adapted here for establishing relative importance of sub-systems in predominantly service oriented cases where such a differentiation can be fuzzy.

The theoretical development and its inherent propositions naturally flow into a process scheme which is the "targeting process."

4.9 The "Targeting Process" Case Study Protocol

The protocol was developed using the framework of Yin (1994).

Purpose

The purpose of the case study is to test the "targeting process" and the theoretical propositions contained in the process.

Key Features of the Case Study Method

This case study is designed to follow the logical order of the targeting process. The study will be a multiple case study, with comparisons for replication and explainable differences in results from case to case which may arise due to the different applications. The organizations chosen for application meet the criteria of being in a "crisis" situation as defined in Chapter 1.

The case study approach is appropriate for use in this application because the researcher did not have control over the participants behaviour nor the systems in which they operate. The study also focuses on contemporary issues, which also indicates the use of the case study as a research method.

The Organization of This Plan

The plan flows from preliminary work to secure the selected applications, through the targeting process. The preliminary steps identify the organization, the key contact people and their positions, and whether they are in a position to implement the results of the application. The case study proper is designed to apply the targeting process and document the results.

I. Procedures

A. Initial Scheduling

There are 3 steps to this process. The first is to select a potential candidate organization which meets the "crisis" criteria. The second step is to contact the organization to determine whether they will support the study. The third step is to establish the level of support for the application, and the key supporter(s) of the study.

The completion of the study requires meetings with key personnel to gather data and to complete specific processes. These activities should take place at the location of the organization being examined. Confirmation of the acceptability of these activities is required when planning the study in the initial stages.

If the project is undertaken internally, management would take the lead in establishing a team directly controlled by senior management for the purposes of developing the target.

B. Determination of Information Sources

After establishing the key contact persons who will facilitate the gathering of the necessary information, the key groups to be interviewed will be agreed on, as will the historical and documented information to be released by the organization for analysis.

The venue for participation by the key personnel should be cleared at this step. As previously stated, it is desirable to have the venue on location for the benefit of those participating, and to provide insight as to what is actually happening in the organization at the time.

C. Tracking Time Required

All major steps and stages are to be monitored for time to completion. Time is a critical component of the arguments for development and use of the targeting process. A measure of time is to be maintained. The measure to be applied is to track in terms of days or fractions of days. A day is considered 8 hours of working time.

II. Case Study Protocol and Questions

A. The Ability to Implement Change

The key questions to be answered are: what levels of authority and commitment are there to implement changes? A key proposition is that the targeting process, to be effective, requires the committed support of people senior enough to drive change. It needs to be determined whether those who are supporting the application have any authority and/or ability to proceed with system change.

B. Establishing the Context: Stage 1 Questions

Purpose

The information required is subjective and reflects the arbitrary views of those who control the organization. This information should be provided directly by senior people at a vice president level or higher (or equivalent). If this level of involvement is not available, the internal supporters can be asked to interface with senior management to obtain the information, or as a last option, provide their input, based on their experience in the organization, to generate the required purpose statement. What is the purpose of the organization? Apply Nadler's methods such as functional expansion to develop a purpose statement for the organization if required. This step is to create a focus on longer term reasons for the organization's existence, rather than strictly focusing on the immediate crisis.

The information resource for this step is the Planning and Design Approach, a workbook by Nadler. This resource provides a step by step approach to the development of a purpose statement.

Customers and Stakeholders

This information can be provided by the internal supporters of the application. It is less subjective than the purpose statement, as there are criteria for deciding who are stakeholders and who are customers. Who does the organization serve? Who are the customers who provide the revenues to the organization? Who are the stakeholders who influence costs?

The participant will create a prospective customer list which will be tested with the "one who pays" criteria to establish the final customer list.

Goals

What are the goals of the organization? What are the outcomes which the company desires? This step is subjective, and requires input from the organization to be accurate. The organization's participant will provide this information. It is usually stated with information such as the vision and mission statements.

Goals should describe what the organization would like to happen, if it was possible. Goals are "likes" or "wants", not "must haves."

Objectives

What are the critical performance requirements which are deemed necessary for the security of the organization? These are the projected outcomes which will alleviate or eliminate the crisis. These will be externally forced on the organization.

The objectives are financial in nature and may be a comparison with current costs and output levels such as a 20% increase in revenues combined with 15% reduction in costs at a 12% increase in production; or as specific numbers such as a $1 million increase in revenues, a $250,000 reduction in costs at the same production levels. The measure should be clear and directly address the crisis.

C. Prioritizing the Sub-systems: Stage 2

Draw a Systems Diagram

This diagram illustrates what production generates revenues and what major sub-systems contribute to the creation of that production. Intermediate goods and services are not shown, only final goods and or services. Knowledge of the business is required to make these distinctions, and thus a representative of the organization is needed to complete this task.

The first question to answer is: What key product(s) generate(s) revenues? This question is addressed by a basic input/output system diagram. The operation is represented by a black box defined in terms of inputs and outputs. The representative of the organization provides insights as to what the key products may be.

The researcher probes the responses of the participant to confirm the answers. The products may be goods and services delivered for sale. For example, a value assembly may be delivered and paid for. The product may be the promise of future delivery based on a specification, design or schedule. An example of this would be an engineering design which wins a tender bid. The "product" which generates the sale in this case is not the goods and services delivered, but rather those prescribed for future delivery. The future delivery affects the customer satisfaction with the sale and final payment, but is not responsible for the sale taking place.

The second question is: What major sub-systems contribute to the creation of the product? This is developed by expanding the "contributing sub-systems" portion to show those that contribute.

The participant describes to the researcher what major sub-systems of the organization provide input to the development of the product, both directly and indirectly.

Prioritize the Sub-systems

This is the most critical step in the success of the targeting process, as it shows the best place to start.

Prioritize the various sub-systems and eliminate areas of low priority from consideration. This serves to focus attention on those areas which, when changed, will make the greatest contribution to improvement. The process requires the assistance of a few knowledgeable inside supporters of the project. It is expected that this step will have the direct participation of the key contacts who have championed the project. The researcher constructs the matrices with the information provided on a sheet of paper, which suffices for the analysis.

The key to the prioritization step is to set up the three QFD matrices following the previously discussed decision rules.

Develop the three matrices which relate: the customer to key output characteristics; key output characteristics to sub-systems; sub-systems to resources. The participant provides the information to be used. The customers have already been identified in a previous step. The key output characteristics are subjective, and may be those previously developed as "quality" measures in conjunction with the development of the organizations vision and mission statements. These output characteristics are general and usually do not translate into product specifications.

The first matrix linking customers to key output characteristics is constructed as follows: The customers are listed down the left hand column, the output characteristics across the top. A solid dot is used to show direct linkage between what the customer wants to pay for and the respective characteristics. This is the only relationship which is important in this matrix.

The participant indicates which characteristics are necessary for revenues. These are directly linked. There may be many other desired characteristics, but these are all conditional on the necessary ones.

The second matrix shows the relation between the key output characteristics and the organization's sub-systems. The sub-systems have already been represented on the system diagram. They may be carried over to the second matrix. As with the previous step, the participant from the organization provides the input as to which sub-systems directly or indirectly contribute to the production process.

The key output characteristics from the first matrix are placed in the left hand column, and the sub-system list is added along the top. The linkage between the key output characteristics and the relevant sub-systems is shown as:

Direct (solid dot) if there would be no product without this sub-system.

Indirect (circle) to indicate support to operations, for example maintenance or supplies.

None (no character) to show no direct or indirect linkage.

When there is more than one direct linkage, a "roof" is added to the matrix to check correlations between the sub-systems. A strong positive correlation is shown with a "+" while strong negative correlations are shown with a "-". Blank means no or slight correlation.

Examine the positively correlated sub-systems for precedence relationships. Which provide support or assistance in creating product, which are direct creator of product?

Negatively correlated sub-systems compete for some of the same resources. Because of this, among the negatively correlated sub-systems the one with the largest contribution to revenues is given the highest priority.

The third matrix identifies the linkage between the priority sub-systems and the resources utilized in creating product. "Resources" may be departments, people, equipment, capital assets such as labs, buildings or inventories. This information requires some knowledge of the particular organization and its processes. It is critical to have some input or substantial information provided to properly complete this step.

The results of this step can vary greatly with the determination of the actual product line which generates revenues. If the determination is that a completed contract is the product rather than an engineering design, the whole focus can be shifted. Care is required to check and confirm this. The design development phase and its direct components may be the critical elements directly linked, even though the costs associated with the final delivered projects may be orders of magnitude higher. In design or prescriptive products, the design or prescription process is the critical aspect, not the actual delivery. The sale has been made, and revenues largely determined long before delivery.

A second look to confirm and a lot of probing are required to make sure that the correct "product" has been selected. If there is some doubt, the system diagram should be revisited and confirmed, and the process rechecked if changes are made to that diagram.

The sub-systems are listed in the left hand column, and the resources are added along the top. Direct linkages (solid dot) indicate a direct contribution of the resource to a particular sub-system. These represent the critical resources required to create a unit of product. Indirect linkages (circle) indicate resources which provide support to product generation but do not directly create the product.

Gather System Data

The question at this step is: What are the data that will give an overall picture of the total production throughput for all the critical sub-systems? The data will be used to rank the high priority sub-systems. The highest ranked priority sub-system will be termed the "Core Production Function." The data also shows the baseline cost and revenue data for the overall system. Generally this data, because it is basically macro data, can be found in the budget or summary accounts of the unit. The data is to be provided by internal sources.

Targets developed will either be in terms of changes to this data in terms of revenues and costs, or will be compared to this data to confirm the amount of improvement indicated by the target.

Diagram the "Core Production Function"

Consideration is now directed to the highest priority sub-system. A detailed precedence diagram of this "Core Production Function" is prepared. The key elements are the major activities involved in creating a unit of product. This requires input and knowledge of the production system and thus participation from within the organization. The step provides an opportunity to envision the components and their interactions. This may provide insight in development of alternatives.

Also included are the resources and key support sub-systems that were shown as having an indirect linkage in the final matrix. Should the targeting process be re-applied to remaining sub-systems, this information is useful in determining which sub-systems may be next in priority.

At this step, caution must be maintained as to whether the product is an immediately deliverable good or service, or the design for a future deliverable. If the process is design related, care is required to not focus on the delivery side, but rather on the design development.

The researcher draws the diagram to illustrate the products and sub-systems as they are related by the participants. This drawing is replicated as a computer generated figure for presentation.

D. Core Production Sub-system Redesign: Stage 3

In this stage the "Core Production Function" is redesigned. There are [illegible] steps to the process: draw the critical activities matrix, gather activity times, separate the activities, and develop alternatives. All these steps require participation from inside personnel with some detailed knowledge as to what actually happens, what outputs are desired, and what may be used as substitutes for existing processes or resources. It is preferred to use people who have hands on experience, but should those not be available or willing, the next best is to gather information using the key group of supporters for the project.

Draw the Critical Activities Matrix

The critical activities matrix illustrates the key activities required for creating a unit of product. It is necessary to identify the activities and the resources required for each activity. Supporting activities, transportation, inventorying activities, paperwork and such are not critical. Only those activities which are required for the creation of the product are included. If the product is for future delivery and is sold on the basis of inherent characteristics, the critical components may be the characteristics rather than the activities used to put them together.

Key questions to ask are: Is this a product or service to be delivered immediately, or in a very short time using set production methods? Is the product or service a design or plan to be delivered at a future date and subject to changes or variances in actual delivery, such as a chemical plant? Is the customer buying what the product or service is, or what it is expected to be at the future delivery date? Is the product or service known with certainty, or merely an expectation based on assumptions of conditions at time of use?

If the core production function represents a design type of process, it needs to be determined whether the critical activities are those in creating the design, or those which are imbedded in the design. A design for future delivery is generally evaluated on the expected costs and benefits of the design's components rather than on the activities performed to prepare the design. An immediately deliverable good or service is usually evaluated based on conformance to specification.

The activity list is obtained by direct observation, or by examining historical records. Process flow charts are a useful way of recording the activities. A critical activity is one which is absolutely required for a successful unit of production. These activities are the ones which add the required value to the completed product. They will be strongly related to the creation of the finished product, whether the product is for immediate use or for future delivery.

The researcher manually draws the matrix using the inputs from the participants, and then develops a computer rendering for the presentation.

To make the matrix: List the resources in the left hand column, the activities across the top. Use an "X" to show which resource is related to which activity. The relationships define what kind of data are required.

Gather Activity Times

A representative measure is required to determine the existing resource requirements and costs associated with the existing output and revenue levels. The key resources are considered, with the existing case used as the baseline measure. Alternatives will be measured in terms of the base case.

Isolate the time, or proportion of time each resource spends on the Core Production Function, and allocate that time to the identified activities. Time spent on non-core activities is regarded as slack. For designs or other "prescriptive" products for future delivery, activity times and resource requirements may be required for those activities which are inside the design. Participants are necessary to provide insights and information for this step. The researcher documents the data for analysis and for presentation.

For each resource, determine slack and productive time, and the allocation of producing time to activities by: direct observation, survey/interview of individuals, or by focus group. These are listed in order of preference which flows from objective to subjective.

Separate Activities

Activities are arbitrarily pulled apart for analysis and development of alternatives. The researcher manually draws the relevant diagrams.

Construct an arrow diagram of the main activities. Examine the diagram to locate activities or sequences that can be isolated. Detach or isolate activities except where they absolutely have to be connected. Precedence is not a consideration. Those "undetachable" connections are not based on precedence but on process. Precedence can be maintained over a delay time by inventorying.

The separated activities can be analyzed for potential alternatives in terms of resources or other inputs which may reduce the cost and/or increase revenues.

Develop Alternatives

The separated activities are next considered for alternatives. The alternatives are in terms of resources or processes which can achieve the same critical outputs, or superior outputs. The relative cost, net of revenues, and resource requirements are to be listed and tabulated for comparison.

This requires assistance from key insiders who can provide experience based knowledge of the processes and some idea of where to look for alternatives. They will also provide key information as to relative values of alternatives and times for activity completion. The first step in developing alternatives is to set up a matrix consisting of alternative means to deliver activities. The researcher facilitates the meeting and keeps notes as to the alternatives created.

Resources are shown in the left hand column, activities are shown across the top. Management determines, through brainstorming, experience and researching trade related information what alternatives activities and resources are available, and what their relative cost is as compared to the existing situation. Potential alternative or additional activities are added to the list along the top. Resource alternatives are added to the list on the left.

The "base case" which corresponds to existing resources is shown in the first rows of the matrix. Key information required to complete the matrix are:

- The relative proportional cost of a unit of alternative resource compared to the existing case.
- The time requirement of the alternative resource to complete the activity. This will be represented as an increment added to or subtracted

from the base case.

The body of the matrix has the boxes diagonally cut into upper and lower halves. The entries in the matrix body are the proportion of resource time required (upper half of box) and the relative resource cost (lower half). Relative cost comparisons are made down a column. Total relative cost is determined by adding horizontally the best values from each column. this will give the proportion of base costs due to system change. The base case resource cost is "1."

To determine the best alternatives mix, the minimum proportional cost is calculated for each column is calculated, and then added horizontally for each remaining activity. This is accomplished by multiplying the top and bottom halves of the respective boxes, placing the product in the box on the bottom row, and then adding the bottom row horizontally, placing the total in the lower right hand box. This total is the proportion of the base case costs which will be realized using the alternative resources. The next item is to calculate any time savings for each resource which can be used to increase production and thus revenues. Note that we are only interested in time savings on bottleneck resources.

In this step, explore alternatives which either increase throughput relatively more than costs or reduce costs for the given production level. The researcher stimulates discussion as to alternatives which serve the above purpose, and lists the alternatives generated by the participants.

The participants use their expertise and perform a critical analysis to limit the list of alternatives to those which are feasible.

E. Process Improvements: Stage 4

Determine the key unchanged processes

The processes which are to be retained and not redesigned as a result of the previous stage are identified by participants internal to the organization. It is useful to construct a process chart to illustrate these processes. The internal participants provide input for the creation of this chart by the researcher.

Gather process data

Historical data are collected for the previous year by the internal participants and forwarded to the researcher. These will be in some type of file form or computer data base. This data must be provided by internal sources, as agreed at the outset.

Determine cause of variability

Simple range charts are developed by the researcher for this purpose. As this step seeks to find obvious areas for improvement, the range charts will suffice to indicate whether variance is between resources or common among them. They are developed by showing the high value, low value and mean value. These are to be arranged in a long chart to allow for visual inspection.

Decide whether to benchmark or reduce variance.

If the variability in the process arises largely from differences between resources, benchmarking is indicated. If the variance is common, variance reduction methods are indicated. Estimates of potential improvement should be developed using input from those associates with the process if possible. If their input is not possible, an estimated target for improvement can be arbitrarily set with input from the internal supporters of the project. Their knowledge can be used as a reasonable substitute for direct input from those who perform the tasks. This reflects a real situation where workers may not be inclined to assist.

F. Describe the Results: Stage 5

The "target" which has resulted from the previous stages and steps is articulated. This articulation shows what the feasible changes developed are, and what the potential savings are. This provides a basis for system change and redesign.

III. Analysis Plan and Reporting

A. Individual Case Study Results

The results of each case will be tabulated and compared to those predicted by the initial propositions and theories to be tested. These results will be contrasted to those which could have been expected using established methods. Explanations are developed for the results as compared to the predicted outcomes.

B. Cross Case Analysis

The individual cases will be contrasted. Two key areas of consideration in this step are replication and explained differences. Has replication been predicted and demonstrated? Are the differences between the outcomes explainable by the theories and propositions which the case was to test?

4.10 Protocol Summary

The logical steps which resulted from the development of the theory and propositions formed the "targeting process." The case study protocol was developed using experience obtained in applying the steps to a hospital and Yin's methods.

CHAPTER 5

CASE STUDY I: THE MISERICORDIA HOSPITAL RADIOLOGY DEPARTMENT

5.1 Introduction

The Pareto Chart, Figure 2.2, page 46, shows the major sub-systems and their related expense levels at the University of Alberta Hospitals. These sub-systems are those which supply services and goods to the "core" production sub-system. The surgical suite, although high priority, was considered outside the direct control of the hospital for purposes of targeting improvements as the processes in this function are directly controlled by doctors. Radiology was chosen as an example of how the targeting process could be applied.

The Radiology Department of the Misericordia Hospital was selected as the organization to study for the following reasons:

- It is the third largest area of expenditure in patient treatment, at 5% of total expenses, behind nursing operations and surgery.
- Cooperation from the Misericordia Radiology Department was readily available.
- There was a willingness to implement selected changes in order to realize productivity gains.

This application enabled validation of the targeting process through the implementation of the suggested changes.

The application also provided validation for the concept of management taking charge and driving the process rather than having empowered teams make the recommendations as to appropriate changes.

The initial discussion for this application took place September 26, 1989 at a TQM Team meeting chaired by Ms. Sharon Toohey. It was suggested that the Radiology Department may be most receptive to a case study of the proposed process. A meeting on October 12, 1989 with Mr. Bill Steinberg, Manager of the Radiology Department, confirmed interest. It was agreed with Mr. Steinberg that the Misericordia Hospital would be the venue for internal participation in the study.

5.2 The Radiology Case Study

Stage 1: Establish the Context for Analysis

The management of the radiology department was very aggressive in its desire for significant change. It set goals which were much higher than any expected requirement from government budgets. There was a focus on staying ahead of the rapidly changing environment in health care funding so that the department could operate in relative independence regardless of the environment. The information and participation for this step were provided on October 30, 1989 by Mr. Steinberg.

The researcher discussed the concepts of the process with Mr. Steinberg, and pointed out some of the features such as exploring enhanced revenue generation as a means of effectively reducing unit costs and improving productivity. This concept was well received by Mr. Steinberg, who agreed that this kind of option may provide some interesting opportunities.

Step 1: State the Purpose

The stated purpose of the radiology department, as provided by Mr. Steinberg for the targeting process is "to improve service levels and reduce costs to keep ahead of the changing budget situation in the province." To achieve this overall purpose, the targeting procedure was applied to determine where significant system improvements are technically feasible.

Step 2: Identify Customers and Stakeholders

The customers to the Radiology Department are both internal and external. The primary customer is the hospital, which "purchases" services to be provided. The radiology department is an internal supplier of services to hospital departments, and receives most of its funding from the hospital for provision of services to nursing units, emergency, ambulatory care and internal clinics. This is in line with Ackoff's profit centre concept. Other customers of significant priority are clinics, the Workers Compensation Board and other hospitals. Insurance companies and patients are customers of lesser importance to revenues.

The key stakeholders are hospital departments, the radiology workers, patients and doctors. The stakeholders include technologists, clerical workers, stenographers, porters, darkroom aides, nursing staff, administrative staff and maintenance staff. Suppliers of various goods and services are stakeholders, but do not participate directly in the operations of the department. Once the internal requirements are determined, then the suppliers will be examined for savings.

Step 3: State the Goals of the Targeting Process

Mr. Steinberg stated that the goals of the increased productivity are:

- To generate extra revenue and reduce costs to the hospital through the sale of increased production to customers outside the hospital, while maintaining service levels to internal customers.
- To help subsidize hospital operations through revenue generation.
- To stay ahead of potential cuts in government funding.
- To achieve all of the productivity increase by increasing throughput.

Step 4: Specify Objectives and Performance Measures

The objectives, also as stated by Mr. Steinberg were:

- To achieve a 33% higher productivity level in the Radiology Department.

This level was chosen by the manager as desired due to the announcement by the government that a 25% reduction in health care costs would be required to balance the budget. It was expected that a 25% reduction to the hospital would be off-loaded onto various departments to minimize the cuts required in nursing care. A 25% reduction in unit costs corresponds to a 33% increase in productivity. The goal is to use the excess capacity for revenue generation to reduce units costs more than the 25%. The margin on external revenues can lower total net costs.

The productivity measure used is the measure provided by Statistics Canada, and currently used as a basis for comparison by the department: the number of exams per hour of direct work. The same level of service to the hospital would be maintained.

Stage 2: Prioritize the Sub-Systems

Mr. Steinberg provided the information and input to complete this stage in two steps. The first was the provision of basic information on October 30, 1989. This was arranged into matrices and tables by the researcher. At a follow up meeting November 14, 1989, Mr. Steinberg completed and confirmed the prioritization steps.

The Radiology and Diagnostic Imaging sub-system comprises 4 major working areas: Radiology, Nuclear Medicine, Computed Tomography and Ultrasound. The radiology department also has major sub-systems in maintenance, suppliers and support areas. The support includes clerical, stenographers, porters and administration. The maintenance sub-system sees to equipment needs. Nursing staff also provide some additional support depending on the needs.

The equipment is capitalized through the operating cost structure, while the building costs are absorbed by separate funding to the hospital from the province.

Step 1: Draw a System Diagram

Mr. Steinberg provided the input required for the researcher to draw the system diagram. The system diagram was drawn in the same fashion as for the hospital system. Patient orders for radiology procedures were the revenue generating production, according to Mr. Steinberg. The operations and sub-systems (listed in the previous section) which support filling of production orders were illustrated.

The resulting system diagram for the Radiology and Diagnostic Imaging sub-system is shown in Figure 5.1. The patient flow is along the horizontal line through reception. The patient is routed to the appropriate type of imaging unit based on the type of procedure required. The support systems provide services as required to the four imaging units. These sub-systems are shown off the patient flow line.

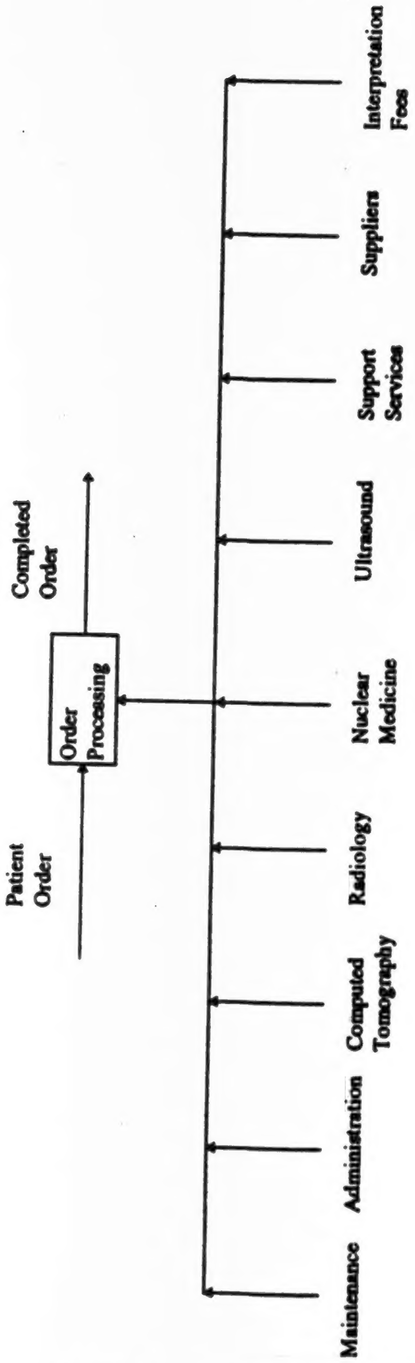


Figure 5.1: Radiology System Diagram

Step 2: Prioritize the Sub-systems

The three QFD matrices relating customers to outputs, outputs to systems and systems to processes are developed next. The information as to customers, output characteristics, systems, resources/stakeholders and processes was drawn from information provided by Mr. Steinberg, as was the input regarding the strength of the relationships to revenues. As this is a Roman Catholic hospital, the list includes items such as spiritual needs which are important to this organization. The researcher manually developed drafts of the matrices from this information. In turn, Mr. Steinberg provided the prioritization inputs using the rules provided by the researcher.

Matrix 1, the relationship between the customers and the key characteristics, is shown first and is based on the information below:

Customers
- Hospital
- Clinics
- Workers Compensation Board
- Insurance Companies
- Patients

Key Output Characteristics
- Cost effective service
- Meet the patients' psychological needs
- Meet the patients' economic needs
- Meet the patients' spiritual needs
- Working conditions
- Workers' educational needs
- Workers' training needs
- Service other hospital departments

Relationship:
● Direct
0 Indirect

Key Output Characteristics

Customers	Cost Effective Service	Meet Patients' Psychological Needs	Meet Patients' Economic Needs	Meet Patients' Spiritual Needs	Working Conditions	Workers' Educational Needs	Workers' Training Needs	Service Other Hospital Departments
Hospital	●							
Doctors								
Patients	●		0					
Workers Compensation Board	●							
Insurance Companies	●							

Figure 5.2: Radiology Customers vs Key Output Characteristics

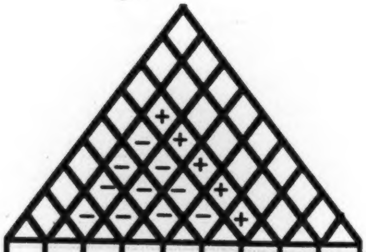
The importance of the characteristic outputs relative to the customers' willingness to pay is shown in Figure 5.2. The areas of focus for productivity improvement are identified by the strength of the relationships. Patients' psychological needs, patients' spiritual needs, working conditions, workers' emotional needs, and worker's training needs did not show a significant relationship based on the objective of productivity improvements, and could be eliminated from further consideration at this time.

The relationship between the outputs and internal sub-systems is shown in Figure 5.3 with the eliminated key output characteristics are crossed out. The relationships carried forward reflect those areas which connect cost to a particular sub-system.

Key Output Characteristics (Remaining)
- Cost effective service
- Meet the patients' economic needs
- Service other hospital departments

The systems which provide those needs are:
- Administration
- General Radiology
- Special Procedures
- Nuclear Medicine
- Computed Tomography
- Ultrasound
- Interpretation
- Support Staff
- Nursing

The completion of this matrix results in the identification of radiology, ultrasound, nuclear medicine and computed tomography as the core production sub-systems based on the application of the decision rules. Those sub-systems with no direct linkage to revenues are dropped from consideration. Those which are linked but correlated in the "roof" are analyzed for precedence.



● **Direct Relationship**

0 **Indirect Relationship**

Key Output Characteristics \ Sub-system	Administration	General Radiology	Special Procedures	Computed Tomography	Nuclear Medicine	Ultrasound	Interpretation	Support Staff	Nursing
Cost Effective Service		●	●	●	●	●	●	0	0
~~Meet Patients' Psychological Needs~~									
Meet Patients' Economic Needs		●	●	●	●	●	●	0	0
~~Meet Patients' Spiritual Needs~~									
~~Working Conditions~~									
~~Meet Workers' Educational Needs~~									
~~Meet Workers' Training Needs~~									
Service Other Hospitals		●	●	●	●	●	●	0	0

Figure 5.3: Radiology Key Output Characteristics vs Sub-systems

The matrix shows that there is some direct dependence between these functions and the interpretation function. Positive correlations indicate a supplier/vendor relationship as more of one requires more of the other. The interpretation function shows a positive relationship with the four core production functions since it supplies a service to them. This places it in a position of secondary priority to the production functions.

Special procedures also has a positive correlation with the core production areas. Special procedures are conducted within each of these areas and are a subset of operations of each area.

Application of the decision rules indicates that these functions can be prioritized by examining the correlations and applying Pareto analysis to determine the highest priority sub-system for those showing negative correlations. The negative correlations in the second matrix indicate that the four core production sub-systems compete for resources. In this case priority is given to the largest area in terms of revenues, according to the rules outlined in Chapter 4. General Radiology accounts for 60% of activity, and thus becomes the priority sub-system for initial analysis.

The third matrix is developed using the information below. This matrix relates the sub-systems to the key resources which are required to deliver the key characteristics to the customers.

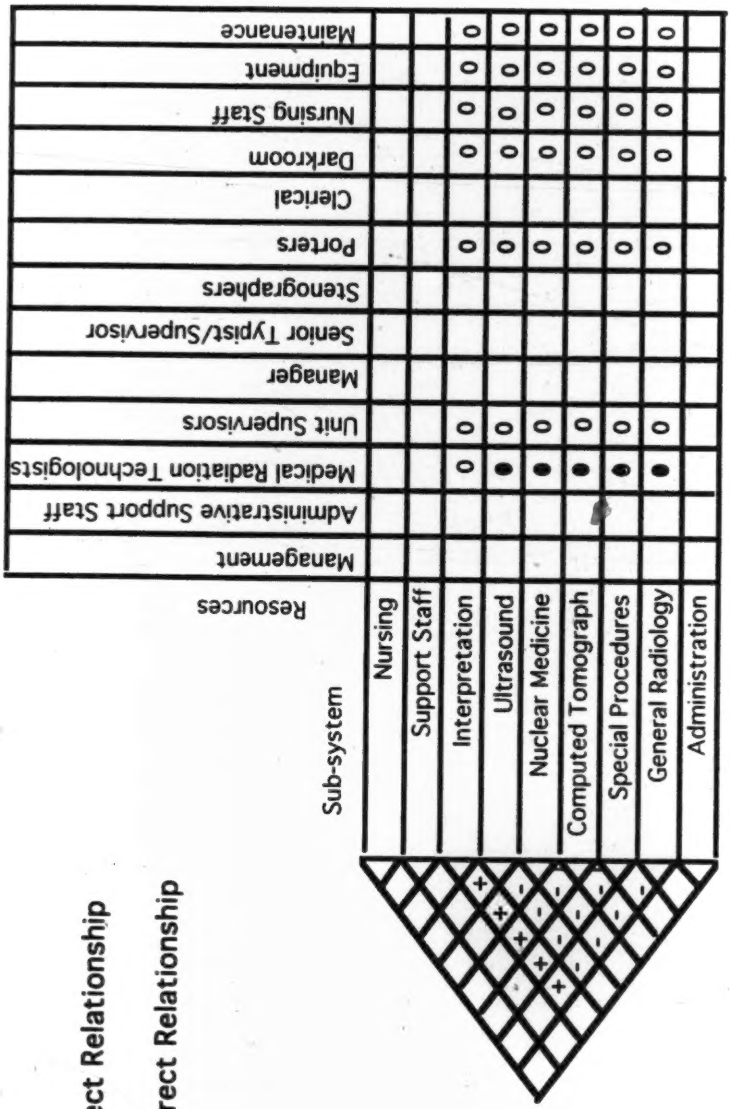
The systems which provide those needs are:
- Administration
- General Radiology
- Special Procedures
- Nuclear Medicine
- Computed Tomography
- Ultrasound
- Interpretation
- Support Staff
- Nursing

The resources which perform the tasks required to produce outputs are:
- Administration
- Management
- Support staff
- Medical Radiation Technologists
  - Unit Supervisors

  Manager
  Support Staff
Senior typist/Supervisor
Stenographers
Clerical
Porters
Darkroom
Nursing Staff
Equipment
Maintenance Staff

It should be noted that if correlations between sub-systems are suspected, but not known, the third matrix can be used to clarify the situation. The key relationship sought is that of sub-systems competing for the same resources. The "roof" of matrix 2 becomes the "front porch" of matrix 3. When the resource comparisons are completed, the "porch" can be checked for correlations. This step is shown in the third matrix.

The revenue linkage to the relevant sub-system is shown in Figure 5.4. The final matrix shows which process/resource items have the greatest effect on revenue generation. The remaining resources directly linked to revenues are those most closely tied to throughput concerns.



Sub-system	Maintenance	Equipment	Nursing Staff	Darkroom	Clerical	Porters	Stenographers	Senior Typist/Supervisor	Manager	Unit Supervisors	Medical Radiation Technologists	Administrative Support Staff	Management
Administration													
General Radiology	0	0	0	0		0				0	●		
Special Procedures	0	0	0	0		0				0	●		
Computed Tomograph	0	0	0	0		0				0	●		
Nuclear Medicine	0	0	0	0		0				0	●		
Ultrasound	0	0	0	0		0				0	●		
Interpretation	0	0	0	0		0				0	0		
Support Staff													
Nursing													

Resources

● Direct Relationship

0 Indirect Relationship

Figure 5.4: Radiology Sub-systems vs Resources

Those resource areas not showing direct linkages are to be addressed after the target is set for the sub-system, as their outputs are determined by the requirements of this sub-system.

Completing the matrices helps focus attention on those areas which are most critical in addressing productivity concerns. Developing the three matrices provides an opportunity to reduce the number of areas being considered for system changes when applying the costing concepts and targeting objectives.

The third matrix shows that the interpretation function supports output from the four core production areas. It will be shown later that this function is the highest cost centre for the department, and that methods such as Pareto analysis would select this area for first consideration. The theoretical approach developed for the targeting procedure places this function at a lower priority level, since the overall throughput level needs to be determined before interpretation needs can be developed.

Step 3: Gather System Data

The system data for the Radiology Department was required to give a basis in terms of throughputs and total costs. This is the base case with which the redesigned system will be compared.

The Radiology Department maintains a great deal of operating data. The following categories were stored in computer files and available for use:

- Staff listings
- Patient numbers
- Patient types
- Number of exams
- Cardiac exams
- Statistics Canada time units
- Direct labour time units
- Applied overhead units for:
    - Transportation
    - Clerical
    - Stenographer
    - Support
- Total time units
- Productivity reports by:

    - Room number
    - Procedure
    - Technician
    - Productivity index
    - Worked hours
    - Paid hours
    - Exams per worked hour
    - Exams per paid hour
    - Units of work
- Examination reports by:
    - Category
    - Patient type
    - Statistics Canada units
- Budget and cost data by:
    - Operations category
    - Actual vs. budgeted
    - Month
    - Expense item
    - Examination
    - Statistics Canada units
- Examination summary by:
    - Category
    - Area
    - Year
- Equipment maintenance reports by:
    - Equipment
    - Cost of maintenance
    - Maintenance schedule

The available data was substantially more than was necessary for the targeting purposes, and reflected Nadler's comments regarding too much data. Nadler (Chapter 4) suggests that data requirements be determined for the particular purpose at hand to avoid handling and processing too much of the wrong or extraneous data. There were so many different types and categories that the bigger picture was obscured by the details. The data selection procedure required care in not getting bogged down in detailed data.

System Data Requirements

The first step in data acquisition was to obtain the department's operating information from the computer files. This information includes both financial and operational information of a general nature. The relative costs for each production function as well as support is shown.

The interpretation fees were an additional charge on production based on the number of exams completed. Mr. Steinberg explained that these were outside the control of the Radiology and Diagnostic Imaging Department because they were done by separate specialists. The charges varied with the number of exams. The costs were charged back through to the radiology function, as they represent part of the total cost of radiology. For these reasons, Mr. Steinberg stated that these costs would be an approximately linear function of the number of exams completed, and would be outside the scope of the targeting study.

The cost levels of this function illustrate how Pareto analysis would prioritize areas for analysis differently than the targeting process. It can be seen from this data that application of Pareto analysis may have initially identified "interpretation fees" as a priority area for analysis. The prioritization rules as set out in Chapter 4 indicate that this function supports the production in the four key areas, and thus has its throughput requirements determined by the output levels of these production areas. Because interpretation is an activity related directly to throughput, it is given secondary priority using the proposed targeting process. Throughput levels in the various radiology units must be determined before analyzing interpretation fees.

This example shows the difference between the non-discriminatory prioritization of Pareto analysis and the systematic prioritization of the targeting process. As Douglas (1992) suggested, Pareto analysis does not indicate relative importance, but rather relative frequency or size.

With a low rework and scrap rate, the manager felt that direct material costs were relatively linear with output and would not provide any significant opportunities for improvement. A continuous improvement plan is in place to reduce losses from this source.

The aggregate cost information for 1989/90 is shown below in Table 5.1. As can be seen, the radiology function is the largest of the four operating areas (radiology, nuclear medicine, ultrasound and computed tomography). The total budget for the 4 areas is $1,146,491. Radiology represents 58% of this, close to the 60% estimated by Mr.

Steinberg. Service and maintenance costs are included in the gross figures below.

Operating Area	Expenses
Radiology	663,649
Nuclear Medicine	191,624
Ultrasound	56,484
Computed Tomography	234,734
Education	78,826
Total Human Resources	1,225,317
Plus Other Expenses	1,584,055
Plus Interpretation Fees	923,590
Total Gross Expenses	3,732,962
(Less Revenues)	(60,775)
Net Expenses	3,672,187

Table 5.1: Aggregate Cost Data for Radiology

Step 4: Diagram the Core Production Sub-system

The researcher developed a rough diagram which was later converted into a computer rendering with direct input from Mr. Steinberg. The core production sub-system comprises 4 main areas: Radiology, Ultrasound, Nuclear Medicine and Computed Tomography.

Since Radiology is the largest of the 4 core production areas it was the key area of focus according to the decision rules established in Chapter 4.

The preliminary comments from the staff were that this area represented the major bottleneck in overall throughput as the other more specialized areas all had slack time available. Radiology was the area most likely to have waiting lines for service.

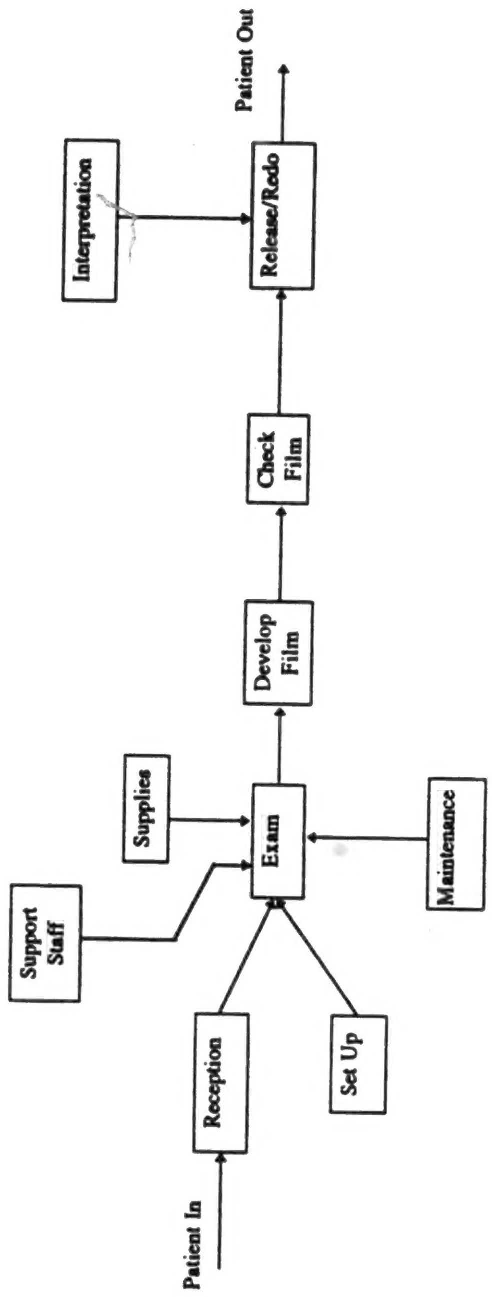


Figure 5.5: Radiology Core Production Sub-system

Stage 3: System Redesign

The information and support for this stage was provided by Mr. Steinberg and technologists on two occasions, January 12, 1990 when the alternatives were developed, and on January 21, 1990 when the proportional cost data for the alternatives was provided. Both meetings were at his office at the Misericordia Hospital. At this time, confirmation was given that there would be movement to implement alternatives.

Step 1: Draw a Critical Activities Matrix

The manager described the general activities flow which was common to all four production areas. The researcher drew a rough representation of the relationships to be converted to a computer diagram. The critical events were listed for use in the critical activities matrix. The manager had a strong understanding of the procedures involved and could easily provide this information. The critical activities matrix is shown in Figure 5.6.

Key Resources / Critical Activities	Receive Patient	Bring Patient Into Room	Set Up For Exam	Conduct Exam	Develop Film	Check Film	Release/Redo
Technician		X	X	X	X	X	X
Support Staff	X						

Figure 5.6: Radiology Critical Activities Matrix

The completion of the critical activities matrix identifies the technicians and support staff as the key stakeholders. These will be the people who should be approached as to development of potential alternative systems designs after completion of the targeting process.

Step 2: Gather Activity Data for Key Resources

The next step was to look at the operating activities and determine which particular data may be of use in developing alternative operating activities or resource allocations to achieve the desired productivity improvements. Mr. Steinberg provided the researcher with support in determining the data requirements, and provided the data for use either directly or by arranging for technologists to be present and provide information and input at a group meeting.

In conjunction with the four core production areas, there are the areas of equipment and maintenance; support supplies and services; interpretation fees; and administration. The equipment will be utilized in the same manner as is the current case, thus information on the maintenance activity will be required. The equipment will not be changed in the short and intermediate terms and increased throughputs will be achieved utilizing time available in all three shifts. The other support services will need to be analyzed after the final throughputs are determined.

The key data areas identified for use were as follows:

- The throughput data available for the core production areas. This information provides the processing rates for the key areas. The data was gathered in the categories listed:
    - Throughput as measured by exams per paid hour.
    - Throughput based on operator.
    - Whether there are patients waiting.
- Data to describe which areas, if any, had overtime paid. This would identify potential bottlenecks.
- The equipment maintenance costs and schedules. Servicing costs represented a large component of the overall costs at $714,541 per year. These, as was

previously stated, were hidden in the overall expenses.

From the diagram and the critical activities matrix, it was determined that the following data and information would provide the basis for analysis:

1. Activity breakdown for the radiology critical activity matrix. Activities are representative of costs for the respective critical activities. The percentage of total processing time spent at each activity is used to represent the percentage of total cost for the process.
2. Throughput measured by total exams with the corresponding hours worked. This measure is consistent with the measure used by Statistics Canada to compare performance among various radiology departments. This is a key measure to improve to realize the objective as stated in Stage 1. The composite information for each sub-system is to be used rather than for individual procedures. A look at the historical data show that the ratios of procedures is substantially the same. Mr. Steinberg commented that over time, procedures tend to average out into relatively predictable ratios.
3. Data showing bottleneck areas. This is represented by incomplete work, carryovers and overtime.
4. Maintenance cost information. The maintenance costs are significant at 10% of total operating budget, and provide opportunity for gains.

Gather Activity Data

The data was collected from the department's records for the previous year and is listed below. The data for the complete previous year provides a representative sample, as it represents the whole population of activity for the year. A comparison with previous years showed that the ratios of activity times relative to body part and exam types were similar.

The activity information was gathered by an interview of Mr. Steinberg and one technologist. With less than 50 persons in the department, an interview was conducted with a technician familiar with the 4 operating areas to determine any bottleneck processes or problem areas as well as the activity breakdown for the radiology critical process map. Mr. Steinberg stated that the major area of persistent, ongoing overtime was the Tech III positions which have additional supervisory duties. These additional duties result in supervisory related work, such as reporting, being competed after the end of the shift, and causing a routine overtime condition.

The percentage activity breakdown for radiology is shown in Table 5.2. The information was developed by Mr. Steinberg with the assistance of the technologists. The remaining data was obtained from the 1989-1990 operating records[1] in the computer files.

Activity	% Processing Time
Get Patient	5
Set up for Exam	25
Conduct Exam	50
Develop Film	15
Check Film	4
Release/Redo	1

Table 5.2: Critical Activity Breakdown for Radiology

The operating data by area for technicians showing the number of exams and worked hours is shown in Table 5.3. The base line and productivity indexes represents exams/budget hours. The productivity data for support staff is shown in Table 5.4. The index numbers represent the number of work units per hour. "Work units" are equivalent to minutes of performing direct radiology activities.

The "baseline" numbers represent averages in the Province of Alberta for these production areas, while the productivity index reflects productivity within the Misericordia Hospital Radiology Department.

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[1] Mr. Steinberg provided complete computer file data for 1989 through the end of 1991 during the course of the study.

Production Area; Technicians	Baseline Index	Exams	Budget Hours	Productivity Index
Radiology	1.10	37,402	34,001.6	1.11
Computed Tomography	.72	3,132	5,220.8	.70
Nuclear Medicine	.46	2,991	6,231.8	.48
Ultrasound	.74	4,209	5,612.4	.75

Table 5.3: Productivity Data for Technicians in each Production Area

Support Area	Baseline Index	Budget Hours	Work Units	Units/Paid Hour
Support - Clerk	40	10,288.00	421,808	41.00
Porters	50	4,170.45	209,148	50.15

Table 5.4: Productivity Data by Support Area

The data related to overtime for Tech III's is shown in Table 5.5. "FTE" refers to full time equivalent. The "overtime pay" column represents the additional cost associated with overtime work. The radiology duties are represented by the specific categories which show an increased level of detail.

Division	FTE	Hourly Rate	Annual Salary 2023 paid hours	Overtime Pay	Total
Lithotripsy	1.0	24.74	50,049.02	6,965.46	57,014.48
Special Diagnostic	1.0	24.74	50,049.02	7,789.54	57,838.56
Nuclear Medicine	1.0	24.74	50,049.02	6,157.26	56,206.28
Ultrasound	1.0	24.74	50,049.02	3,709.44	53,758.46
CT Scanning	1.0	24.74	50,049.02	3,596.48	53,645.50
Total	5.0		250,245.10	28,218.18	278,463.28

Table 5.5: Tech III Overtime Cost Data

The data for equipment maintenance costs is shown in Table 5.6. Due to potential for bulk service contract rates, the GE WPX/RPX units are included "no charge" according to the bid proposal. The "fee for service" column represents the base case for purposes of comparison. The "service contract" column represents an alternative.

Equipment/Area	Fee for Service	Service Contract	Difference
Seimens CT	155,017	105,971	49,046
Nuclear Medicine	93,921	76,345	17,576
Angiography	94,604	64,500	30,104
GE WPX/RPX	24,621	0	24,621
Lithotripsy	258,565	65,753	192,812
Ultrasound	53,229	32,280	20,949
Portables	12,630	8,496	4,134
Processors	21,954	8,970	12,984
Total	714,541	362,315	352,226

Table 5.6: Equipment Maintenance Cost Data

Step 3: Separate Resources/Activities

Separate Activities

Mr. Steinberg confirmed that there were three areas to be separated. These are the operating process, the Tech III process which includes overtime, and the maintenance function. These are shown in the following series of figures.

Operating Processes for Radiology

Separation of the operating process for radiology was based on possibilities for alternative methods. This step was facilitated by participation of technologists on January 12, 1990. It was assumed that the exam could not begin before the patient had been brought in, and that the patient could leave the room before the decision to rework or release was made. This enabled separating the process into the following groups:

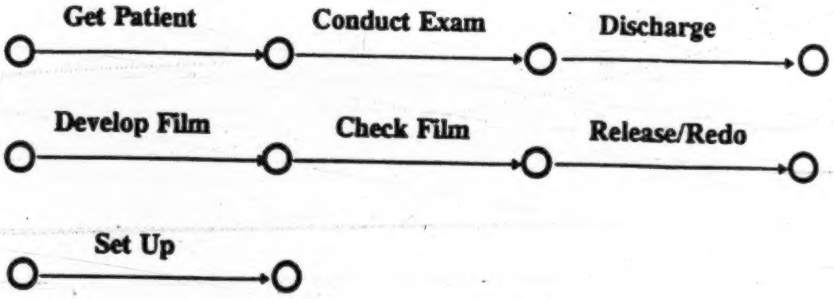


Figure 5.7: Separated Radiology Activities

Technologist III Overtime

The Tech III's had regular functional duties as technicians, but additional supervisory roles. This required overtime. The separation was not of the tasks but rather of the hours worked and the pay rate.

Maintenance

The maintenance function was separated from regular operations in the previous step. This was achievable by following the industrial practice of scheduling maintenance during the slow shift from midnight to eight A.M., instead of existing methods of doing maintenance during the day time or on an unscheduled basis as required by technologists. The next focus on maintenance was similar to the Tech III situation. The cost needed to be separated from the level of maintenance.

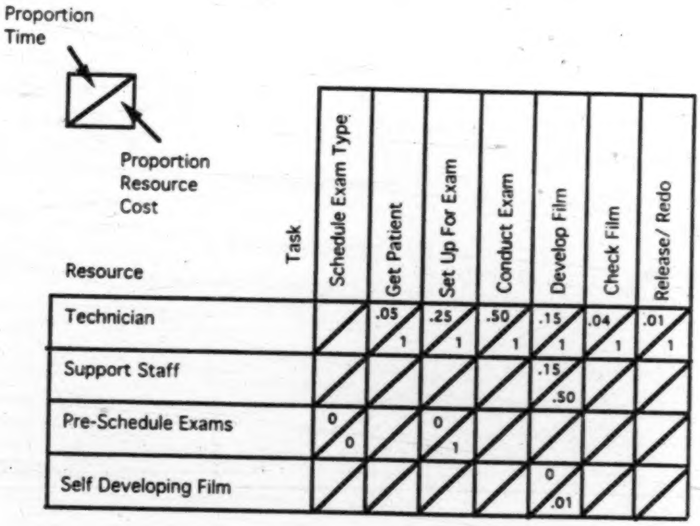
Step 4: Develop System Alternatives

The alternatives for each area were developed using input from Mr. Steinberg and his technologists. These steps were an action item at the January 12 meeting. The alternatives were developed internally and forwarded to the researcher on completion. These were forwarded January 19 and tabulated by the researcher.

Develop Alternatives Matrix

The alternatives matrix developed using the information provided by Mr. Steinberg and his technologists is shown on the following page.

The set up times could be effectively removed from consideration for all except emergencies by scheduling exams by body area. There were several machines which could effectively handle all body parts without affecting other hospital treatment areas. Scheduling would further reduce the chance of problems relating to other departments' activities. The shift is split into 4 parts by lunch and coffee breaks, and exams could be scheduled to fit this scheme. Rather than setting up for each patient as they were brought in and determination of the exam type was made, technicians could set up for scheduled exams. The schedules would reflect the extra time available due to diminished set up times. Emergencies could be routed to the appropriate technologist if possible. Patients could also be scheduled to arrive in less utilized shifts. This could be convenient for both patients and technologists. Treatments would not likely be affected, as actual treatment times are generally low, and the patient spends a lot of time just laying in bed receiving little or no attention. this would also be conditional on patient's condition: more critical cases would have more constraints. The day shift has consistent waiting lines, and moving exams to other shifts would generate an increase in throughput.



Task Resource	Schedule Exam Type	Get Patient	Set Up For Exam	Conduct Exam	Develop Film	Check Film	Release/ Redo
Technician		.05 1	.25 1	.50 1	.15 1	.04 1	.01 1
Support Staff					.15 .50		
Pre-Schedule Exams	0 0		0 1				
Self Developing Film					0 .01		

Figure 5.8: Radiology Alternatives Matrix

The film development process could be redesigned in two ways: self developing film and darkroom support staff. This would free the technologist to begin another exam while the film was being developed. In this manner, each exam would have a slight increase in time, but the overall throughput rate would significantly improve. It would take longer to make the release decision.

The development of the QFD matrices in Stage 2, in conjunction with the objectives of Stage 1, indicate that cost factors are more important than patient convenience. The patient was considered to be work in progress (an industrial perspective), with little or no inventory carrying cost.

Technologist III Alternatives

The Tech III alternative developed was to promote the Tech III's to supervisors, with a nominal pay raise. Supervisors are salaried rather than paid on an hourly basis. The pay schedule was based on discussion with the Tech III's as to what level would be suitable.

Division	FTE	Unit Supervisor	Annual Salary 1958 paid hours	Total Tech III Pay	Difference
Lithotripsy	1.0	24.85	48,656.30	57,014.48	8,358.18
Special Diagnostic	1.0	24.85	48,656.30	57,838.56	9,182.18
Nuclear Medicine	1.0	24.85	48,656.30	56,206.28	7,549.98
Ultrasound	1.0	24.85	48,656.30	53,758.46	5,102.16
CT Scanning	1.0	24.85	48,656.30	53,645.50	4,989.2
Total	5.0		243,281.50	278,463.28	35,181.78

Table 5.7: Tech III vs Unit Supervisor Cost Data

In the absence of any other changes, this could be considered a defacto wage reduction. However, workers would be empowered to adjust their work to complete their tasks within a normal shift and thus realize an hourly wage increase. The suggested approach would see a slightly higher base pay level, with the opportunity to reduce the workload. This idea was favoured by the workers.

Maintenance Alternatives

The maintenance alternatives related to timing and who does it. The timing issue was resolved quickly in favour of off hours maintenance. Some routine maintenance could be accomplished by the technologists in the evening and grave yard shifts, but major maintenance needed specialist personnel. The alternatives were to order fee for service maintenance or to contract the job. Examination of the relative costs, as shown in Table 5.6, indicate that substantial savings could be realized by contracting maintenance. The savings was due to bulk discounting. The large amount of maintenance enabled a suitable firm to bid at a reduced cost. The savings calculated for the following year indicate a savings of over $300,000.

Stage 4: Process Improvements

Step 1: Determine Key Remaining Processes

The key remaining activities, according to Mr. Steinberg, were the actual exam procedures. The times to complete the actual exams are recorded in the historical data. This information provides the basis for determining causes of variability. The remaining processes are shown in Figure 5.9.

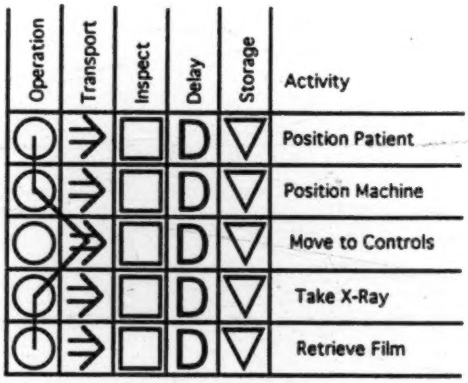


Figure 5.9: Continued Radiology Processes

Technician	Statscan Units/Exam	Range
1	11.74	11.40-11.95
2	11.98	11.61-12.41
3	11.90	11.66-12.23
4	13.24	12.78-13.64
5	11.52	10.98-11.87
6	11.40	11.02-11.71
7	11.45	10.98-11.93
8	11.38	10.97-11.75
9	11.61	11.23-11.88
10	12.08	11.76-12.38
11	11.83	11.62-12.13
12	10.91	10.57-11.22
13	11.42	11.09-11.81
14	13.85	13.12-14.55
15	11.05	10.77-11.33
16	22.84	18.99-24.67
17	12.93	12.55-13.39
18	15.04	14.77-15.41
19	15.86	15.11-16.76
20	12.55	12.05-12.99
21	10.98	10.67-11.22
22	10.94	10.71-11.20
23	16.29	15.56-17.13
24	15.61	14.89-16.31
25	14.18	13.37-14.88
26	12.36	12.01-12.56
27	12.26	11.87-12.55
28	10.47	10.22-10.77
29	18.88	17.79-20.55
30	10.30	10.03-10.71
31	10.58	10.13-10.88
32	11.98	11.47-12.65
33	10.44	10.11-10.97
34	12.25	11.76-12.93
35	11.13	10.55-11.73
36	11.26	10.81-11.47
37	11.29	10.79-11.69
38	11.60	11.02-11.99
39	11.23	10.49-11.91
40	12.61	11.88-13.23
41	11.59	10.87-12.12

Table 5.8 : Productivity as Measured by Statistics Canada Units per Exam

Step 2: Gather Process Data

Data for this stage was provided by Mr. Steinberg May 20, 1991, and covered the 12 month period ending April 30, 1991. This stage was completed after the implementation of previously developed changes. Mr. Steinberg felt that the major changes could be handled first with any process improvements considered later.

The "Statscan Units/Exam" are equivalent to time in minutes. The times shown are for the portion of the exam utilizing the radiology equipment such as X-Ray machines. The film development and moving of the patient into and away from the room are not included. The data are shown in Table 5.8.

Step 3: Determine Cause of Process Variability

The operating data for exams vs time for each technician were visually analyzed, and except for new trainees, the variability was determined to be between the technicians. The averages and ranges are shown in Table 5.8. The manager stated that even if the variability was among the technicians, the best levels would be used as goals, and that the "best" in each category would present their methods to the others. This indicated that Procedure A should be used, and that a benchmark should be established.

Procedure A: Benchmarking

The order statistics were developed for the mean exam time for each technician. These are shown below. The best performance was chosen as the target or benchmark. The technicians with the benchmark performance provided short presentations to the others as to how procedures were conducted.

Technician	Statscan Units/Exam
30	10.30
33	10.44
28	10.47
31	10.58
12	10.91
22	10.94
21	10.98
15	11.05
35	11.13
39	11.23
36	11.26
37	11.29
8	11.38
6	11.40
13	11.42
7	11.45
5	11.52
41	11.59
38	11.60
9	11.61
1	11.74
11	11.83
3	11.90
32	11.98
2	11.98
10	12.08
34	12.25
27	12.26
26	12.36
20	12.55
40	12.61
17	12.93
4	13.24
14	13.85
25	14.88
18	15.04
24	15.61
19	15.86
23	16.29
29	18.88
16	22.89

Table 5.9: Order Statistics for Radiology Technicians

Procedure B: Variance Reduction

The variability for the technicians' procedures was not considered high by management when variances in patient throughput were considered. Management believed that fluctuations in patient arrivals would make variance reduction techniques difficult to apply. The throughput measure in terms of Statistics Canada Units per exam at the beginning of the application were already better than the national average.

The range groupings of the data indicate that the best productivity near the 10 Statscan units per exam approaches a realistic lower limit for time per exam. The focus was to use this level as a performance goal.

Stage 5: Articulate the Target

The final target is presented as a technically feasible means of achieving the desired performance requirements as stated in Stage 1.

The final target consisted of 4 parts:

1. A New Procedure for Radiology (including scheduling body parts to specific technicians during the shift, and self developing film).
2. Addressing the Tech III Overtime Issue.
3. Changes to the Maintenance Program.
4. Benchmarking the Best Practices.

1. New Radiology Procedure

The proposed procedure shown in Figure 5.10 below is expected to generate a 30% improvement in throughput utilizing the same resources. The procedure features the inclusion of scheduling to reduce set-up times and self developing film to provide more time for technologists to increase the number of exams.

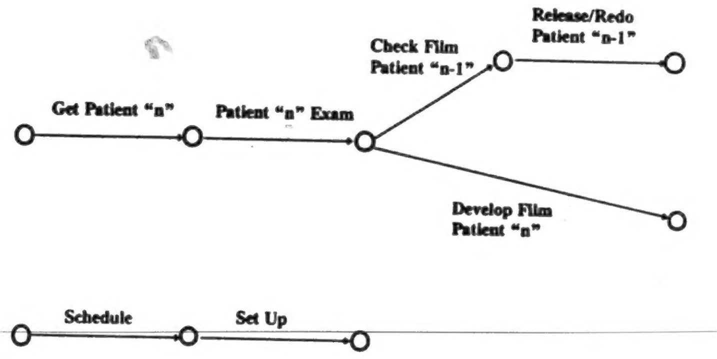


Figure 5.10: Proposed New Radiology Procedure

The proposed system is expected to realize a maximum of 40% cycle time reduction if the full savings in set up times and film development times is realized. Approximately 60% of the workload is the day shift. Since there is slack in both the evening and night shifts, it is expected that the full savings will not be realized. An estimate of 25% (approximately 60% of 40%, or the day shift portion) will be used to express the proposed savings from the operating system changes. This will allow for emergency exams and film development time in the slack shifts. The scheduling of exams by type also enables a heavier workload to be assigned to the second shift, reducing slack and spreading the productivity gain.

2. Changes to Tech III Status

The Tech III's are to be promoted to supervisory positions which will provide total expected savings of $35,000 per year. This is to be implemented immediately. As previously discussed when the alternative was developed, this would not be a wage reduction if the workers choose to improve their efficiency and complete their tasks within the standard 8 hour shift. They would be empowered to make changes to achieve this. This would provide motivation to reduce the workload and realize an increase in hourly wages.

3. Maintenance Changes

Maintenance will no longer be handled on a fee for service basis, but will be contracted. The expected savings are approximately $300,000 per year. This is to take place immediately.

4. Benchmarking

The benchmarks provided by the analysis are to be implemented by the respective technician delivering a presentation as to how this level of productivity is achieved. The current workload in radiology is 22,306 exams at an average of 12.6 Statscan Units per exam. The benchmark of 10.3 units represents a time saving of 18% for the average exam. While the exams are trending to more be specialized and less general, it is expected that most of this savings can be realized for the day shift, which has the heaviest load. The expected increase in throughput potential is 8%. Some gains will be realized by scheduling more work to the second shift, which will reduce the amount of slack there.

The total expected cash savings are $335,000 per year with an improved throughput potential of 33%, meeting original required results.

5.3 Summary

The targeting process as applied to the radiology sub-system achieved the results in the time frame shown below. As was the case with the nursing example, the project was conducted by one person with information inputs from various stakeholders. The times in days are given for each stage.

The changes to maintenance were implemented, as were the other changes. Productivity in the radiology department after the changes is shown below.

Production Area; Technicians	Baseline Index	Exams Before	Budget Hours	Perf. Index Before	Exams After	Perf. Index After
Radiology	1.10	37,402	34,001.6	1.11	51,568	1.52
Computed Tomography	.72	3,132	5,220.8	.70	5,348	1.02
Nuclear Medicine	.46	2,991	6,231.8	.48	3,456	.55
Ultrasound	.74	4,209	5,612.4	.75	5,912	1.05

Table 5.10: Post Targeting Productivity Comparison Data for Technicians

Support Area	Baseline Index	Budget Hours	Work Units	Units/ Paid hour Before	Work Units	Units/ Paid Hour After
Support - Clerk	40	10,288.00	421,808	41.00	593,443	57.68
Porters	50	4,170.45	209,148	50.15	405,934	97.32

Table 5.11: Post Targeting Productivity Data Comparison for Support Staff

The "baseline index" refers to the provincial average for the particular area, the "performance index before" refers to the Misericordia Radiology Department performance before changes, while the "performance index after" refers to the performance after changes. The indexes refer to exams per hour, a higher number being better.

The comparisons for the support staff show the baseline, before and after change results of completed work units per paid hour. Again, higher is better.

The increased productivity resulting from implementing the changes is equivalent to an additional:

6.37 FTE in Radiology Technicians

2.32 FTE in Clerical workers

2.02 FTE in Porters

1.09 FTE in Computed Tomography

0.70 FTE in Nuclear Medicine

0.98 FTE in Ultrasound

This represents an additional 13.48 FTE, approximately 1/3 increase. These additional FTE were calculated by the Province of Alberta in an audit conducted in 1991. These improvements resulted in the hospital receiving $2,000,000 extra per year in provincial funding. This was equivalent to approximately 1/2 of the yearly budget for the department. Revenues for provision of outside services were also up slightly.

Stage 1: The first stage took one day to complete.

Stage 2: Stage 2 required two days for completion. This included the gathering of a significant amount of the data required for Stage 3.

Stage 3: The third stage was completed within two days. The activities data was available from the previous step. The time frame for this stage was reduced due to the prompt estimate of the maintenance contract. Obtaining this information could extend the time frame, as it requires information from outside the organization.

Stage 4: This stage took one day to complete. The major factor in this step was obtaining the range data for the exams.

Stage 5: This step was completed in one morning, or a half day.

The total time for this project was six and one half days. The time was less than the nursing example due to the significantly smaller size of the operation. A large scale survey was not required, and the staff provided prompt responses to questions. Extra time was required to sift through the large amounts of data available to find appropriate data for the process. The computer files contained an overabundance of information, much of which was not useful to the study.

CHAPTER 6

CASE STUDY II: Q'MAX SOLUTIONS INC., DRILLING FLUIDS FIRM

6.1 Introduction

An application in a drilling fluids firm was selected as a confirmatory case study. This case arose from other research work conducted for the firm by the researcher. On learning that there was a process available to target productive change, Q'MAX Solutions Inc. expressed a desire to apply it in their firm. This provided an opportunity to apply the process where there was unconstrained and cooperative management.

The firm provides drilling fluid services and systems to the Western Canadian oil industry. The industry in Canada is mature, with exploration and development focused on new production from known formations and enhanced production from existing wells. The commercial success rate for drilling is in the 80 to 85% range, depending on the year. "Dry" holes or "dusters" usually have hydrocarbons present, but not in commercial quantities. There is oil or gas present in almost every hole.[1] In this environment, low cost is a key factor for economic success. All service firms are under pressure to reduce the price to customers.

Due to these factors, there was a strong commitment from management to implement any changes developed. This provided an opportunity for further validation of the targeting process through implementation of the results generated. The firm's President, Mr. Reginald Northcott, the five owners, and all senior management personnel supported the project. Mr. Northcott was the contact person within the organization responsible for the application. Discussions began October 16, 1995, and the project commenced in late October.

Since the firm was a recent start-up business in a sector which is highly price competitive, an ongoing crisis was in effect. The firm was, and is, in a position of having to develop more productive means of delivering services to survive and grow.

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[1] This information was provided by Q'MAX President Reginald Northcott and is based on weekly and yearly reports from Oilweek and the Nickel Oil Bulletin.

The firm began operations two and one half years ago. Initial staffing was 12 persons, which grew to 44 by the spring of 1996. The productivity improvement targeting began in late fall of 1995. Completion of the first phases was completed in April, 1996. Thus the whole process from inception to implementation took less than six months.

The targeting process and protocol were applied.

6.2 The Drilling Fluids Case Study

Stage 1: Desired Outcomes

The steps in this stage were completed at one meeting with the researcher taking notes and facilitating the steps.

Step 1: Purpose

A meeting was held at Q'MAX offices on October 21, 1995 with the President and other owners of the firm to develop a statement of purpose. A suggested process was outlined to management by the researcher. After a few minutes, the President responded "we have a purpose statement." The owners of the firm, at its inception, developed their own "purpose" statement. At their insistence, it was used.

"The purpose of Q'MAX Solutions is to be successful in the drilling fluids industry by improving the profitability of our customers."

Step 2: Customer/Stakeholder Identification

At the same meeting, Mr. Northcott identified the customers, based on the "one who pays" criterion as oil and gas exploration companies or divisions of oil and gas firms that undertake this function. For simplicity, Mr. Northcott described them as "the oil patch," a commonly used term.

Stakeholders identified were the owners of the firm, employees and suppliers of goods and services.

Step 3: Goals

The stated goals, as described by Mr. Northcott (same meeting) are as follows:

1. To increase our importance to our customers.
2. To provide a secure working environment for employees with opportunity for advancement.
3. To be the supplier of choice for our customers.
4. To continually improve quality of service provided.

Step 4: Objectives/Performance Measures

The key performance objective was to provide a value of service which was 20% better than the competition. In a highly price competitive environment, it was felt by the owners that the survival and growth of the firm was contingent on being significantly better than established firms in the sector.

The key measure of value to be used: time to "pay back" of the well for Q'MAX's service as compared to the competition. This reflects the stated purpose of improving the customers profitability. Q'MAX owners stated that the key measure of success used by their customers was time to pay back on the investment in the well. The context for "value" from here on in this case is related to the time to recover the cost of drilling a well.

These steps took less than 3 hours at one meeting.

Stage 2: Prioritizing the Sub-systems

All the steps in this stage took place at a meeting with Mr. Northcott November 2, 1995, with the system data provided representing 12 months to the end of October, 1995. The researcher took notes and prepared the rough diagrams and matrices based on inputs from Mr. Northcott, who also provided the decisions and confirmation for the prioritization steps.

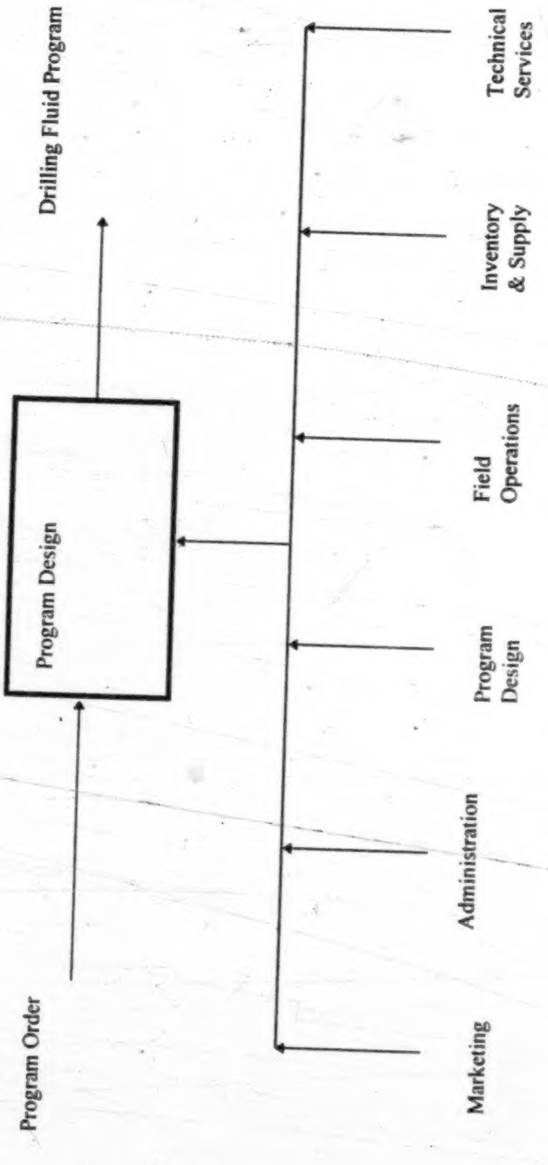


Figure 6.1: Q'MAX System Diagram

Step 1: Draw a System Diagram

The first act in developing the system diagram was to determine what the key revenue generating output of the firm is. Mr. Northcott stated that the product which generates revenue is "drilling programs." When asked to explain, he said that the sales people identify needs, and then have the program people design a drilling program for the particular application. The customer then decides whether to purchase this program.

There may or may not be a tender process involved. A significant part of the program is a description of the net benefits to the customer. Successful sale of a program leads to field implementation to program design.

The key product, as shown in Figure 6.1 is the drilling fluid program. Inputs to the creation of the program are: marketing, administration, program design, field operations, inventory and supplies, and technical services. Mr. Northcott outlined that previous records and performance as well as research into regions and formations was utilized, and that learning from previous experience was critical in fine tuning the program designs for cost control. The key inputs are also shown on Figure 6.1.

Step 2: Prioritize the Sub-systems

The three matrices were developed to prioritize the sub-systems for analysis. These were completed in manual form and then converted to a computer generated form for reporting purposes.

The customer was "the oil patch."

The key customer characteristics, as described by Mr. Northcott to the researcher are:

Low Cost Service
Value
On time Service
Conformance to Administrative Requirements
Continuous Improvement of Services
Delivery to Specification (meeting price, service quotations)

Relationship:
● Direct
0 Indirect

Customers \ Key Output Characteristics	Low Cost Service	Value	On Time Service	Conformance to Administrative Requirements	Continuous Improvement of Services	Delivery to Specification
Oil Patch	0	●	0			0

Figure 6.2: Q'MAX Customers vs Key Output Characteristics

The first matrix which establishes the linkage between revenues from the customer and the performance characteristics is as shown in Figure 6.2. Mr. Northcott indicated that the key variable linked to revenue was value. In the field, unknown or unexpected occurrences happen regularly. For example, there may be fractures in the rock formations which result in loss of fluids. These types of things may be difficult to predict accurately. The customer wants to know that given what conditions existed when the hole was drilled, was the service of good value, allowing for unknowns.

The second matrix, Figure 6.3, shows the continuance of the linkage between the key characteristic, value (left hand column), and the sub-systems of the organization:

marketing
administration
program design
field operations
inventory and supplies
technical services

Completion of this matrix shows that the key sub-system linked to revenues is "program design."

● Direct Relationship

0 Indirect Relationship

Key Output Characteristics \ Sub-system	Administration	Marketing	Program Design	Field Operations	Inventory & Supplies	Technical Services
Value			●	0	0	0

Figure 6.3: Q'MAX Key Output Characteristics vs Sub-systems

The third matrix, which links the sub-systems to resources was then developed. The sub-system being considered from the previous step was:

program design

The resources utilized in developing program designs, according to Mr.

Northcott were:

- marketing personnel
- programmers
- technicians
- research personnel
- clerical staff
- field personnel
- operations staff

● Direct Relationship

0 Indirect Relationship

Sub-system / Resources	Marketing Personnel	Programmers/Programs	Technicians	Research Personnel	Clerical Staff	Field Personnel	Operations Staff
Program Design	0	●	0	0	0	0	0

Figure 6.4: Q'MAX Sub-systems vs Resources

The third matrix, Figure 6.4, shows the linkages. The direct linkage was with the programmers, with indirect linkages to the other resources, who provides support to the development of the programs.

Step 3: Gather System Data

Broad based system data was provided by Q'MAX. This data represented the general sub-system expenses and the corresponding number of wells serviced.

Revenues	$7,287,321
Marketing	600,000
Administration	563,333
Program Design	151,236
Field Operations	1,682,031
Inventory and Supply	3,294,051
Technical Services	136,766
Total Expenses	6,427,417
Net Revenues	859,904
Wells Drilled	287

Table 6.1: Systems Data

"Program Design" was the key function directly linked to revenue generation. This was the second lowest cost function at Q'MAX. The partners expressed surprise at this conclusion, but agreed, based on the logic of the process that this area was indeed the critical one. Normally, field operations were considered critical. Field operations completes the delivery of the services sold in the programs. This is similar to an engineering firm that sells engineering designs via tender and then completes the project later. The completion is important, but is not directly responsible for the sale. The owners agreed that they would not have focused attention on this area first without having used the targeting process.

Step 4: Diagram the "Core Production Subsystem"

The core production sub-system, as indicated by the prioritization step, is that of "program design." This provided a deviation from conventional focus away from in-field operational cost containment towards overall effectiveness based on net benefit to the producer. Two Request for Proposal (RFP) packages sent out by Petro Canada Inc. and Esso Resources Ltd. were developed to allow for this change. The Petro Canada proposal due date was July 22, 1996. The prioritization of this area provided a completely new focus for these clients.

Management was then asked to assist in drawing a flow diagram of how the program design process goes, including key supporting inputs. The researcher prepared the diagram based on the information provided. This diagram is shown in Figure 6.5.

The prioritization stage took approximately 3 hours.

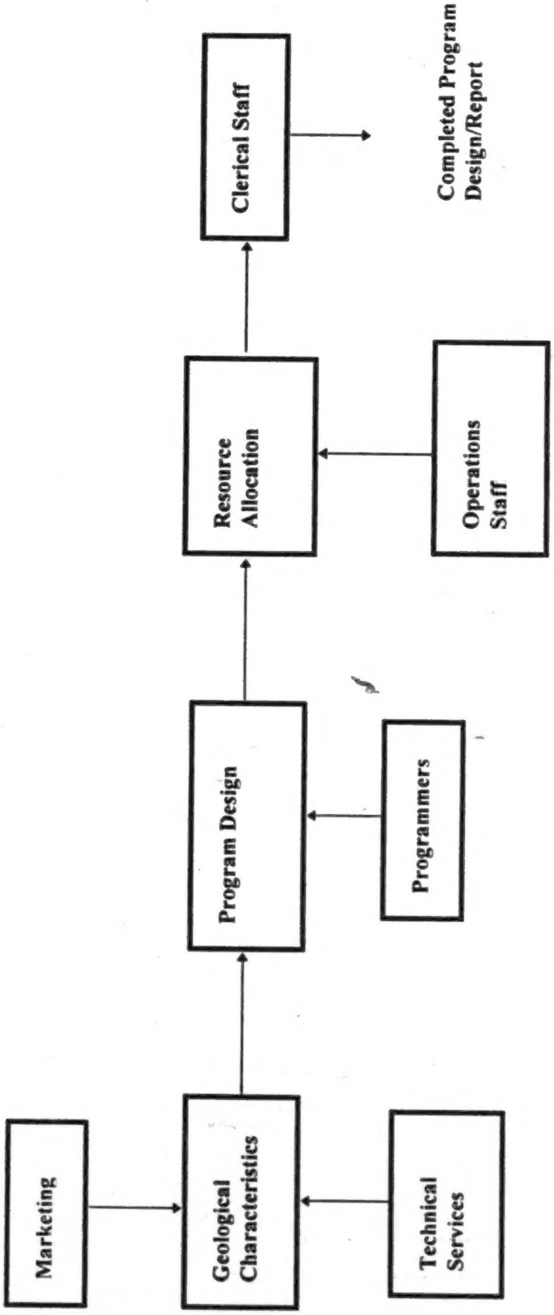


Figure 6.5: Q'MAX Core Production Sub-system

Stage 3: Core Production Sub-system Redesign

This stage was completed over the course of 4.5 months. There was significant involvement from Q'MAX, their partners and the researcher. The researcher managed the steps in the process and provided facilitation. The key activities of developing alternatives were performed by Mr. Jim Maskewicz, a partner in Q'MAX.

Step 1: Draw the Critical Activities Matrix

On the afternoon of January 4, 1996, Mr. Northcott brought in the programmers and developed a listing of the critical activities for program development. The development activity time for each well was about the same, regardless of the type of hole. The question became: what are the critical activities to study? Mr. Northcott referred to the "purpose" of improving profits to the customer, and suggested that the critical activities and associated resources were those which would be designed into the system to be sold.

As the programs were designs of drilling fluid systems, they were sold on the basis of the components and the perceived effectiveness of these components. Delivery would be against the design parameters. Mr. Bill Hans, a Q'MAX partner commented that there were normal variances in drilling, as it was never sure as to what would be encountered. The ability of the program to robustly perform was a key factor for success in making the sale.

In short, the key activities and resources were not in developing the program but rather those which were in the program, as these were what was being sold. In the drilling fluids case, the programmers' direct costs are minimal relative to the total cost, but the programs determine the costs of delivery in the field through the drilling program. This program is what the customers purchase.

These critical activities focused around two major areas: the well bore between ground level and the pay zone, and the well bore in the pay zone. Prior to the pay zone, the only opportunity would be to reduce costs, as this created no revenue enhancement potential to the client. Within the pay zone, the programs affected both direct expense as well as production.

Discussion among the programmers reached the conclusion that prior to the pay zone, there were standard fare practices which hinged on actual conditions and circumstances in the overburden formations. Data on these were limited, as most of the attention in the industry has been on obtaining data on the producing formations.

A review of 600 wells performed by Mr. Maskewicz indicated that only in rare circumstances, less than 25 wells, were there opportunities for reduction in costs for this phase. The exceptions were lost circulation due to fractured formations, sloughing of the hole, and sticking of the bit in the hole. These are all difficult, if not impossible, to predict with existing information. Fault tree analysis is used to predict a probability of what may be encountered, but uncertainty remains. It was concluded that this portion of the drilling was similar to standard opening moves in chess, the real "game" started when approaching the pay zone.

The agreement was to focus on the pay zone activities and resources required. The activities groups were:

Determine expected production: oil or gas

Determine the nature of the formation

Design fluid systems for the formation and production

Develop resource consumption and service requirements profile

Operations scheduling and inventory requirements planning

These activities are shown below in Figure 6.6.

Key Resources / Critical Activities	Identify Well & Formation Type	Select Fluid System	Develop Materials Consumption Profile	Establish Operating Protocols	Forward to Operations/Sales
Programmers	X	X	X	X	X
Program Inventory		X			
Resource Consumption Records			X		

Figure 6.6: Q'MAX Critical Activities Matrix

Step 2: Gather Activity Times

At the close of the January 4, 1996 meeting, it was agreed that by January 11, the base case activity data and costs would be gathered for oil and gas wells, and the group would re-convene. These data included base case average time and resource costs. The resource costs were based on expected time to pay back the cost of the well. This was the critical measure in terms of value to the client. Comparison for alternatives would be based on relationship to this measure. The averages were developed over the previous 287 wells, which was the total for the 12 months prior to October 31, 1995.

The average activity times were as follows:

Oil

Well bore drilling	
Pay zone drilling	
Introduce fluid system components	1 day
Monitor and adjust fluid system	5 days
Circulate fluid	5 days
Time to pay back	3 months

Gas

Well bore drilling	
Pay zone drilling	
Introduce fluid system components	1 day
Monitor and adjust fluid system	7 days
Circulate fluid	7 days
Time to pay back	4.4 months

Step 3: Separate Activities

At the January 11 meeting, the activities for drilling in the pay zone were separated for consideration.

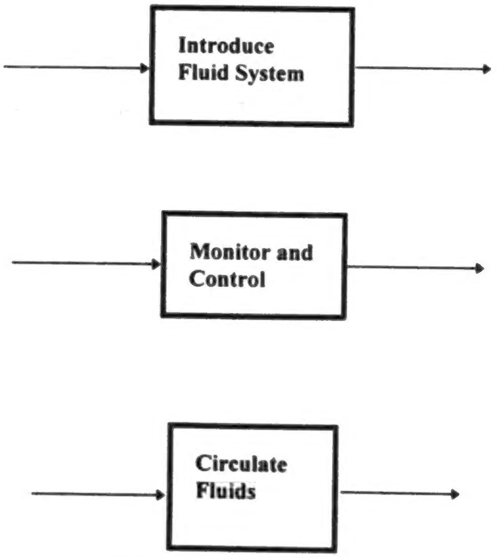


Figure 6.7: Separated Q'MAX Activities

Step 4: Develop Alternatives

The focus of the January 11, 1996 meeting was to identify potential areas for change. Mr. Jim Maskewicz sat in for Mr. Northcott. Potential alternatives were developed for the critical elements of the drilling activities: the fluid system and management during the pay zone drilling for each of oil and gas. The circulation and monitoring operations offered no opportunity for change. The key areas for change were determined to be in introducing the components. This step reflected directly back to the systems design process which determined what those components would be.

A quick analysis by the programmers determined that there would be little opportunity for significant improvement using existing designs and materials, as these were common to the industry. Only marginal improvements would be possible. It was suggested by Mr. Jim Maskewicz, a partner in Q'MAX, that potential may exist to improve the well performance by reducing the amount of damage to the pay zone which normally occurred during drilling. This would affect the time to pay back, but would not change other activity time levels. The change would be to replace resources with better performing ones. The catch was that these would need to be developed.

This resulted in the development of two major research projects. The first was a $60,000 effort to reduce damage in gas wells. Q'MAX began this project January 18, 1996, with assistance from Pan Canadian Resources. Over a three week period, core samples were re-constituted to simulate real conditions and damage, and alternative methods and fluid systems were analyzed to reduce the damage. The results were a reduction in producing formation damage averaging between 95 and 100% for gas wells. A proprietary fluid system was developed, and a patent application filed.

Two test wells were drilled, one by Pan Canadian, the other by Petro Canada. The increased flow, compared to existing methods was 27%. The cost differential was less than 1%. An additional two months were required to complete the wells and confirm the test results.

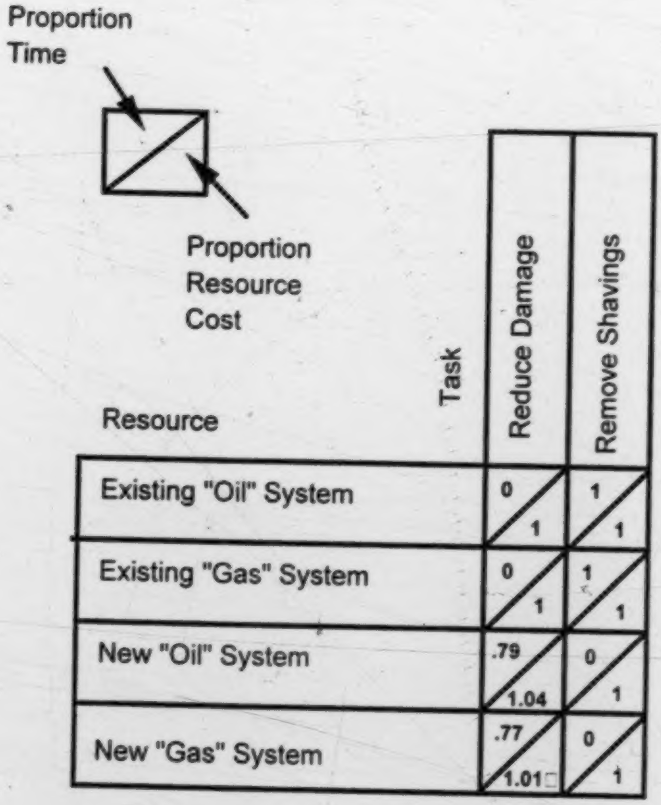
The alternative is shown in Figure 6.8, which is the alternatives matrix for relative resource cost versus activity time. The cost is measured in terms of pay back to the client. The existing fluid systems gas drilling provide no damage reduction.

These provide the base costs for drilling. The new fluid system for gas drilling was intended to reduce the damage caused by the drilling process. The "pay back" factors (upper half of the box) for the existing system were "1" while those for the new system were .79, even though the resource cost was 1.04 times that of the base case (lower half of the box). The new fluid design provided for the removal of the shavings at no incremental cost, thus no increase in pay back time.

The second project resulting from the January 11 meeting was to reduce damage in oil producing formations, and was under the control and direction of Mr. Maskewicz. The major damage mechanism identified was through invasive damage caused by the drilling fluid. A means was sought to reduce this invasion. The unique solution, resulting from a novel application of plastics technology, was to artificially plug the formation as it was being drilled, and then dissolve out the plugs on completion. This project began immediately, with a proposed solution developed by January 31, 1996.

A test well was planned for early February, but was delayed until mid-March. The test well logged out with 100% of the pay zone producing, versus a normal 50%. The measured increase in flow was 35%. The increase in cost was 4% over conventional methods.

These results are indicated in the table in a manner similar to those for the gas drilling system. Shavings removal incurs no incremental cost over the damage reduction component of the system. The existing systems provide no damage reduction, only shavings removal. The pay back time as a fraction of the base case is .77 versus "1."



Resource	Reduce Damage	Remove Shavings
Existing "Oil" System	0 1	1 1
Existing "Gas" System	0 1	1 1
New "Oil" System	.79 1.04	0 1
New "Gas" System	.77 1.01	0 1

Figure 6.8: Drilling Fluids Alternatives Matrix

This alternative is also shown in Figure 6.8. The alternatives provided reduced pay back times of 21% and 23% for oil and gas respectively, allowing for increased costs.

Completion of development of these alternatives resulted in two patent applications being prepared with the researcher's assistance. Petro Canada used the developments to successfully bid at a land sale for property previously deemed not commercially viable.

The remaining process which could be considered was a nitrogen injection method used in what is called "under-balanced drilling." This approach uses a fluid of sufficiently low density to allow for production while drilling is taking place. This is achieved by having a hydrostatic pressure head lower than that of the formation. This procedure is indicated in 10-20% of wells, depending on the specific drilling programs in the patch for a particular period.

This process is highly variable, but as yet no alternatives to nitrogen have been developed. A development project has been undertaken by Q'MAX, in conjunction with 3M to develop an alternative. This project is just underway, and is expected to take over one year to complete. In the meantime, the existing methods are to be used.

Stage 4: Process Improvements

The information for this step was provided at the January 11, 1996 meeting. The follow-up project was contracted to TJC Tech Inc., to be completed by Mr. Cliff Alexander, President of TJC. The author is representing Q'MAX in completion of the means to implement the targeted solution in this ongoing project.

Step 1: Determine Key Remaining Processes

The key remaining process is that of nitrogen injection to reduce density of the drilling fluid. This operation increases penetration rate, reduces formation damage and allows for production during the completion of the well. The cost of nitrogen, at $25,000 per day, was the remaining major cost which had the potential for significant reduction, according to Mr. Northcott.

Well #	Low Density	High Density
1	2.8	6.0
2	3.0	5.9
3	3.1	5.8
4	3.2	5.8
5	3.0	6.0
6	2.9	6.0
7	2.7	5.9
8	2.7	5.7
9	2.9	5.7
10	3.0	6.0
11	2.8	6.3
12	3.0	6.2
13	3.2	6.0
14	3.1	6.3
15	2.7	6.0
16	2.9	5.9
17	2.8	5.7
18	2.7	5.9
19	3.2	6.0
20	3.1	6.1
21	3.3	6.2
22	3.1	6.0
23	3.0	6.0
24	2.9	5.9
25	3.0	5.7
26	2.7	6.0
27	2.8	5.9

Table 6.2: Density Variability Data

Step 2: Gather Process Data

The process data gathered was the records for the fluid density on all wells which Q'MAX supplied services and nitrogen was used. These were provided as part of the January 18 information package. The density sheets were obtained for 27 wells. The sheets show the changes in density due to the control of the nitrogen injection. The desired density is .6, while the actual densities were between .3 and .6. The charts show a "sawtooth" shape, largely fluctuating between these points. Due to this "sawtooth" shape, the average highs and lows for each well were tabulated for comparison.

Step 3: Determine the Cause of Variability

Table 6.2 shows that the variability from high to low within a given well was greater than the variability from well to well. Within a well, the variability ranges from about .3 to .6, while between wells, there is less than .1 difference between the high values and a similar spread between the low values.

Step 4: Benchmark or Variance Reduction Methods

Comparing variability between the wells, to the variability within a given well, it can be seen that the major source of variability is common to all wells. Mr. Cliff Alexander of TJC Tech Inc. was commissioned to provide an estimate of the potential savings achievable by reducing this variability. The average density of the wells was calculated to be .45. By approaching a .6 density average, thereby reducing the variability to "0" nitrogen requirements could be reduced by approximately 1/3, allowing for compressibility, according to Mr. Alexander.

Bench tests with a small scale mixing and control system indicated that the minimum range achievable would be a density between .5 and .6 for an average of .55. This would provide a savings of over 25% in nitrogen costs. This target for variance reduction was selected, and a technical product development project was initiated to create the system which will enable this performance.

Stage 5: Articulate the Target

Q'MAX President Reg Northcott articulated the target for the researcher. The productivity improvement target established was as follows:

1. Introduce the new fluid system to reduce formation damage in gas wells, which will provide the client a net reduction in pay back period of approximately 20%.
2. Introduce the material into the fluid systems of oil wells to reduce invasive damage, reducing the client's pay back period by 20-25%.
3. Complete development of the control system for nitrogen based under-balanced systems to provide a 25% reduction in nitrogen costs.

In addition, Q'MAX will pursue the alternative fluid development to replace nitrogen with a lower cost, more controllable option. This fluid will have to be 20% lower in cost than the improved nitrogen system to be accepted.

The total time to complete all the tasks, alternative product development and implement the changes was under 4 months. Total complete time for the project, including initial meetings and start up was under 6 months.

6.3 Summary

The application of the targeting process led to some unique results which would not have been sought by Q'MAX. These in turn resulted in patent applications and improved sales. The sales were of higher cost systems which reduced the overall pay back time for the client, increasing profitability. One client received major gains by using the developments to dramatically change a previously unprofitable field into a commercially viable one. This in turn generated additional business for Q'MAX and the opportunity to develop another supplier partnership.

CHAPTER 7: SUMMARY, DISCUSSION AND CONCLUSIONS

7.1 Summary

The purpose of this research was to clarify which individuals should develop system changes, and to propose a targeting process that will determine feasible change. The targets can then be used as a basis for major improvements.

Initially, the objective was to determine significant productivity improvement changes in a hospital environment. The study began by attempting to utilize TQM tools to develop these productivity improvements. It became quickly apparent that a means to establish priorities was needed, and that TQM had no prioritizing mechanism. It also became apparent that the empowerment based methods would not work in cases that were obvious win-lose situations for the workers. Hospitals in Alberta were rapidly approaching a crisis with the Provincial Government threatening and then implementing major budget reductions.

The next step in the research was to examine the literature for crisis management techniques and theory described in Chapter 2, section 2.3, regarding management and leadership issues. The crisis techniques found focused on cost reduction rather than productivity improvement as the means to address the crisis.

Hirshhorn pointed to the need for managers to lead in a time of crisis, since the defense mechanisms of the workers will generally prove to be counter-productive. Ackoff suggested that senior management should develop a default position for change which could either be implemented, or used as a basis for the development of further alternatives. In combination, these two factors suggest that part of management's leadership could be in the form of taking charge by developing the alternatives for change.

Building on the initial experiences at the University of Alberta Hospitals, a framework was developed for establishing feasible targets. The customer focus of TQM was combined with QFD to tie the complex production system components together. Goldratt's theories provided the basis for prioritizing of the sub-systems based on revenue generating throughputs. In a manufacturing setting, bottlenecks and impediments to productivity and revenue generation are more easily determined. In a complex service organization, it is not so easy to identify the priority system.

Data and information from the initial hospital investigation was used to develop the targeting process and define a protocol for further case studies. The theory and process evolved by way of addressing the problems encountered in applying the methods to the hospital system.

There was no general overall hospital application, so it is not known if it would have worked in that case. No conclusion could be drawn as to whether the targeting process would have led to a successful resolution of the crisis. The key lessons learned from this case were that TQM could not effectively establish priorities, and a systematic means of prioritization was required. It was also confirmed that a lack of senior support leads to failure of the process.

Evolution of the targeting process was a result of the research into the hospital operating environment. This investigation illustrated the need for more research and development on the front end in terms of context and prioritization, rather than focus only on potential changes. The major outputs from the lessons learned in this case were the prioritization portion of the targeting process and the development of approaches for further applications.

7.2 Case Results and Analysis

The case study protocol was applied to two cases, and the analysis follows that outlined in the protocol.

Radiology Case Study

The application in this case saw strong support and determination from the unit manager to develop and introduce change to avert a crisis due to government budget cuts. This support proved critical in follow up implementation and success. Workers were given the opportunity to work towards achieving management's goals and objectives, but not to set the agenda.

Establishing the targets took 6 and 1/2 days of working time. This was spread over 3 months. Implementation took place over a two year period.

By establishing a formal context for analysis, increased production and revenues were options in the redesign process. No prior constraints were placed on how to achieve this end or where to start. The initial focus was to look for ways to increase revenues with increased production. This provided a win-win situation for employees, and created an environment where there was willing participation and support for the change process. This circumstance led to rapid implementation. It appears that change development and implementation may be able to be fast tracked if a win-win context is established.

The prioritization scheme did not focus on the highest cost area, but rather on that most closely associated with revenues. The reduced constraints provided by the targeting process kept the increase production option open, as the focus was not entirely on costs.

The targeting process suggested changes which increased the revenues of the organization by increasing throughput. Actual operating costs increased, but less than the corresponding increase in revenue generating ability. Slack time was generated by substituting lower cost resources (self developing film for technicians) and in turn used to generate more throughput.

Promotions were used as a means to reduce resource costs. This situation which involved the Tech III's provided a potential loss for the employees, and thus could have been a "default" position. When asked about the potential change, the employees were willing to trade the overtime pay for the non-monetary benefit of having "management" positions. In effect, they accepted the default. However, it was not a simple switching of money for time. The Tech III's were "empowered" to change their circumstances and actually increase their hourly wage.

The targets which were developed for the radiology application were implemented as they were developed during the project. There were several immediate gains. The Tech III's were promoted to supervisory positions yielding the expected $35,000 per year gains (refer to Figure 5.5). Maintenance was contracted rather than jobbed out as required which yielded savings of $600,000 over the following two years (refer to Figure 5.6). The resulting staff productivity gains when compared to provincial averages showed that the level of output attained would normally require 1/3 more staff.

This application saw strong commitment by the manager to achieve results. It was clear who was in charge of the operation, and where responsibility lay. The focus of the productivity improvements was to stay ahead of the proposed budget cuts and to be the low cost supplier in the industry. It was felt that maintaining this position would be the only hedge against any foreseeable government budget action. The resulting combination of increased throughput and unit cost reduction netted close to a 50% reduction in the Radiology Department costs.

A summary report[1] issued November 26, 1991, states:

> "...an operational review was carried out encompassing the entire Diagnostic Imaging Services. This review identified that the level of present productivity would require an additional 14.35 F.T.E. This review was submitted through the Vice President's Office to the Department of Health. The results of this assessment was supported by the Health Department's Imaging Consultants. It is my understanding the Misericordia Hospital received approximately $2,000,000 as a result of the total Hospital review..."

A key component of the success of this application was that management held the view that major changes and improvements were possible, and that more would be possible in the future. There was a feeling that there are no long term constraints to productivity.

The targeting process has the potential to be applied to remaining sub-systems in an orderly fashion. This ability to "cascade" through the entire organization provides a systematic means to develop alternatives for a complete organization.

Application of the targeting process in Radiology provided an example of how the process could be cascaded through a large, complex organization. In a hospital, after completion of the first step which identified nursing care as the core production area, subsequent analyses could be undertaken to develop targets for supporting sub-systems such as radiology. The structure of the targeting process is such that it may be applied in levels with the order determined by the priority established at the first application. In this way, the targeting process provides a systematic means of analyzing and developing alternatives for an organization of any size or complexity.

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[1] Summary Report, November 26, 1991, prepared by Bill Steinberg, Manager of the department of Radiology and Diagnostic Imaging, and submitted to the Misericordia Hospital

Drilling Fluid Results

This project had strong support from senior management and the owners. There was determination to avert the crisis of being shut out of business or being forced into a cost competitive mode of diminishing margins. This was a key factor in the success of the program. The management of Q'MAX specifically sought application of the process to develop alternatives which would provide for growth for their firm. The management was cooperative and unconstrained and supported the effort at every step. It was a top down driven process.

The targeting process yielded results in less that six months. The major time requirements were for research and testing of alternatives, and for in-field testing. This time period saw the development and commercialization of two new products, including patent applications, as a result of the process. In addition, there are two additional product development projects which are under way.

Context was important in allowing interesting and innovative alternatives in this case. The key focus of making the customer more profitable placed few limitations on the range of possible solutions. This is in keeping with the purpose of this stage: to indicate what the requirements of the targeting process had to be, while keeping constraints to a minimum. The context provided a win-win alternative, with failure to develop alternatives being potentially disastrous for the entire organization. There was strong support at all levels of the organization which led to orderly development and implementation of the results.

In the drilling fluids case, a very low cost overhead function, program design, was selected as the area for initial consideration. The targeting process prioritizes on revenue effects, and not with relative expenditure levels. This provided a non-standard starting point. The differentiation between products for immediate and for future delivery was a factor in this prioritization which was arrived at due to the concept of where revenues are generated.

The core activity levels chosen for analysis were those within the drilling fluid system designs, not the actual design process. The fluid system design process was similar for any system, the key differences which related to the clients' profitability were the components of the fluid systems. Thus, the activities which were to be redesigned were those within the programs. This shifted the focus away from the processes used in the designing of systems to component characteristics which would be delivered at the future date. Again this provided a different view to improving the design process: not by changing the process so much as by changing the outputs of the process.

The targeting process generated significant potential improvements which would meet the objectives of a 20% value advantage over the competition. Two of the three targets were more costly than conventional methods, but yielded considerably more value than the conventional methods. This solution was possible as the targeting process does not constrain costs.

The third improvement was a cost reduction for an existing approach. All the solutions amounted to substitution of resources and systems, without a processing time change.

Conventional methods in this industry have focused on the operations side and not on product development as a means to increase productivity. "Operations" accounts for most of the expenditure, and would have been a primary candidate for reduction. Since conventional methods do not set the context formally nor prioritize based on revenues, the likely courses of action would have been to focus on reduced margins, inventory management and squeezing suppliers. Since the firm is a new organization (a "start up" company), these approaches may have had limited success, as established competitors are already using these methods.

Q'MAX has implemented these changes in their programs. They have achieved a supplier partnership status with Shell and Pan Canadian due to their methods. Petro Canada and Husky are negotiating similar agreements at this time. Significantly, much of the improved relationships with these clients has resulted as much from the use of process to develop new and improved methods as from the new methods themselves.

This was an unexpected result. Both Shell and Pan Canadian indicated that the development process was critical in their decisions to participate in the partnerships.

The project developments have resulted in one patent application, with another forthcoming. Ongoing research is being conducted in partnership with 3M for new low density fluids.

Cross Case Comparative Analysis

Both cases illustrated the need for senior level support for success in facing a crisis. Where senior management is determined to find and implement change, the process can be successful. Both cases also saw management leading the way and remaining in charge of the agenda.

By focusing quickly on the priority area for analysis, the targeting process was able to find alternatives in very short order, and shift the focus to how to implement solutions, in the cases where implementation was sought.

Establishment of the context prevents preconceived views to cost and production reductions, and helps reduce constraints as to how to achieve desired results. In the Radiology and Drilling Fluids cases, increased revenues were considered as potential options. Taking the step of establishing the context for addressing the crisis helps to focus thinking on longer term goals and requirements, while still keeping attention on the short term objectives. The context proved to be a key as to whether there was opportunity for a win-win with employees or not. This factor can provide early indication as to whether the alternatives developed will be used as a default position for employee involvement or whether they can be readily implemented.

The Radiology application selected an operations area as the priority one for initial analysis. This area was not the highest expenditure one in the Department, but was prioritized based on connection to revenues.

The priority in the drilling fluids case was what was considered an overhead/administrative type function, not an operating area. Careful examination showed this to be the critical area for revenue generation.

The prioritization step selected different areas for predictable reasons. The priority area in the Radiology case may or may not have been selected first using conventional means; and the drilling fluids priority area would likely not have been selected as priority using any conventional means.

The process may be cascaded to cover the whole organization in a systematic fashion using the prioritization rules.

Feasible alternatives were developed in all cases. The radiology case saw alternatives which created slack time for the highest cost resource by substituting a higher cost self developing film for a lower cost film. The slack was used to increase production and thus revenues.

Alternatives developed for the drilling fluids case were new products to be used in existing processes. These were higher price to the client, but reduced time to pay out for wells. The changes were not in how the programmer develops the drilling programs, but rather what components are used. The targeting process, by not constraining how changes are to be made, allows for this latitude.

The targeting process was successfully validated through implementation in the radiology and drilling fluids cases.

7.3 Validity

The criteria for validity as outlined in Chapter 1 were met.

1. Construct Validity.

Operational procedures were established; a chain of evidence linked to the theory and propositions was established; multiple sources of data were used; and information provided by key participants was studied. The development of the operational procedures was concurrent with the exploratory hospital research. The process steps were developed while researching hospital operations, and the operational procedures refined from there. The resulting protocol was applied in the subsequent cases. Application to the radiology case followed a lagged sequential use of the developed protocol, as there was some overlap in the total time period for these cases. As a stage was developed, it would be applied. The Drilling fluids case saw formal application of the completed protocol.

2. Internal Validity.

The results of the case studies were consistent with the developed theory and propositions. Propositions developed placed importance on senior level support; establishing a context; prioritizing the sub-systems to determine where to start; unconstrained development of alternatives; and looking for final process improvements.

Application to radiology demonstrated the benefits of establishing the context in providing a clear indication to employees as to the situation. It also served to demonstrate the need to not overly constrain the process. Allowing for revenue increase leads to more alternatives. By constraining where to look, rather than what the changes are to be, production increases were allowed and developed. By removing the "cost" focus, actual costs were increased while total costs per unit decreased. The targeting process is flexible to allow for this.

Q'MAX applied the process as a survival mechanism for a new company. They demonstrated as well that senior level management was key, establishing the context was critical in reducing limitations to alternative development, and that a very minor expense area may be critical. The selection of the program design area was surprising to the Q'MAX staff, but was consistent with the "priority based on linkage to revenue" scheme of the targeting process.

3. External Validity.

The targeting process was replicated in two case studies. The radiology case began after partial completion of the hospital case, and utilized the procedures and protocols as they were developed. The complete, final protocol was further applied in the drilling fluids case.

4. Reliability.

The case study protocol as established for this case was subsequently applied satisfactorily.

7.4 Discussion

The "targeting process" was synthesized as an extension of existing practice in TQM and systems design to be applied to crisis situations. This synthesis resulted in a series of logical stages with imbedded steps which formed the basis for the process. Time requirements for developing targets are reduced, while constraints are minimized.

Behaviours indicated by the research into workers' responses to crisis situations was seen in the hospital case, but was absent from those cases where management remained firmly in charge of the change process. The hospital employees exhibited very predictable behaviour in their responses to any proposed changes.

Establishing the context for analysis prevents mis-conceptions or preconceptions as to what should happen or where to first look. The customer is kept in the loop, albeit in a different way. Rather than focusing on specification, the focus is on the customer as a source of revenue. Rather than focus on cost reduction or reduced production, both established "quick fix" methods, there is a longer range view based on the overall purpose of the organization.

One clear result was the importance of this step in both reducing constraints as to alternatives. Related to this is that this step makes it clear as to whether the alternative developed will be a default or one ready for implementation. It was not initially expected that there would be such a powerful connection between the context established, senior management support and implementation. This step proved to be a very useful departure from more conventional crisis management methods which tend to assume a cost reduction context initially, which can severely constrain the development of desirable alternatives.

Prioritization for analysis is a major contribution. Adapting QFD matrices and extending the throughput based costing concepts of Goldratt to a systems wide approach for crisis situations provides a useful management decision tool for systematically establishing relative priority of various sub-systems within an organization. This prioritization ignores any preconceptions and offers an objective means of determining priority.

Each case had some unique features in the prioritization step. Application to radiology established an operational area as priority for first redesign, but did not choose the highest cost sub-system for first consideration. The key linkage to revenues pointed to the radiology procedures.

Drilling fluids application surprised those in the firm by selecting the drilling programs as the priority. This was one of the lowest cost areas in the firm. All sales are based on the programs, however. The operational functions deliver the components of the sold programs. The operational areas are traditionally considered the primary ones, with an industry focus on cost reduction. Selection of the program design area offered a new perspective as to where the greatest benefits could be achieved.

The prioritization method has only one constraint, that is the linkage to externally derived revenue. Careful determination of what actually results in revenues leads to the first priority area for change. All other changes are then constrained by those made to this priority area. Prioritization can be systematically applied to remaining sub-systems after any level of application, until there are no sub-systems to be analyzed. This systematic prioritization procedure is a unique departure from current crisis management schemes which do not allow for complex system interactions or a linkage to the customer. This is externally focused prioritization rather than conventional internally focused approaches.

Using relative resource cost and activity times provides a useful basis for comparing alternatives. These alternatives may be developed in a relatively unconstrained manner based on critical activities to be completed. This reduces the requirement for detail data; a major benefit for senior management.

The radiology application saw process change and introduction of higher cost supplies to free up time from an over-utilized resource as means to increase production and in turn revenues. New products and processes were developed for the drilling fluids case. These were higher cost than existing systems, and countered the industry move to lower cost. By increasing benefits to the client relatively more than cost, the increased cost was welcomed.

The target which results is useful for either direct implementation or as a means to shift focus within the organization for the purpose of internally generated additional alternatives. This make the process robust for use as a default position where empowerment based methods are to be used, or where direct management intervention is to be used.

7.5 Conclusions

During the development of the targeting process through to the completion and analysis of the cases, several key conclusions were reached.

1. There is a need for a targeting process in complex service organizations.

Where QFD and Goldratt's methods have been successful in manufacturing settings, service organizations are more complex requiring a more structured means of establishing linkages to resources and processes, and to determine priority areas for change. In manufacturing, a bottleneck machine which limits production and thus revenue is obvious because of the queues and overtime. In a service based organization, it is not so obvious. Slack time on a machine is easy to determine, whereas people find other activities which may blur the proportion of productive time. It also may not be clear as to which processes are actually the key ones in generating revenues. In this environment, a targeting process becomes necessary to identify priority processes and generate improvements.

The targeting process carries the customer through to the sub-systems which helps to identify where the critical revenue generating activities are. Depending on whether the "product" is for immediate or future use, the process can give some very different priorities as to which activities are key. These results are sometimes quite different from what would normally be expected.

2. The need for a rational, systematic method to establish priority.

At the outset, the research focus was on generating productivity improvements within a TQM system, and in ways which were compatible with TQM. Previous experience indicated that the University of Alberta Hospitals environment would provide a good opportunity to develop and test methods for identifying alternatives for major improvement in a TQM environment.

It quickly became apparent that while everyone seemed to know that nursing needed to be looked at, the TQM focus was on small impact areas which offered little chance of major improvement. TQM in this application was unable to focus efforts on an obvious area where big improvements could be made.

Research into crisis literature indicated that factors such as denial, failure to recognize and act on problems and individual defense mechanisms would delay or inhibit any progress towards resolution of a crisis. The crisis would then grow until the only options were very short term methods to cut costs and reduce cash flow requirements, in turn forcing a cost reduction priority on the organization.

3. The need to develop a target without worker involvement.

In a crisis, management needs to take charge and exercise its right and responsibility to manage in the best interests of the organization. The workers' given the opportunity, will place their own interests ahead of the organization's, especially when those interests are in conflict. In a crisis, the scope of worker decision making must be limited to minimize the deviation from the organization's objectives.

TQM, re-engineering, and other recent change processes advocate a high level of worker involvement and empowerment. However, there is strong resistance in the hospitals to any change which would cause a reduction of services or job loss. The nurses argued that there was no way to reduce expenses without cutting service and losing quality. In the absence of any alternative, there was no way to successfully argue this point.

The nurses' position demonstrated the defence mechanisms which come into play during a crisis, and how these mechanisms work against a successful resolution.

The negative aspects indicated that it might be useful to develop a feasible alternative without worker input to demonstrate that the changes could actually be made. The development of the target would shift focus away from the notion that it could not be done to one of is there any other ways to do it. This could diffuse the whole argument against change.

The Xerox wiring harness case provides an example of this. When the plant was threatened with closure, the situation was changed from one where many workers could lose to one where there was incentive for all to develop a better alternative. In the case of the NUMMI plant, workers were willing to assist because the plant had previously been closed, and all were laid off. When the focus shifts to one where there is opportunity to make things better, more support can be expected. This requires establishment of a base case from which to improve with workers' help. In a crisis situation, where there is a good chance that the workers would suffer, the development of this target would change the focus to whether there were other alternatives which might be more preferable.

Management must lead during times of crisis to avoid and/or exercise some control over the types of mechanisms that come into play. Their leadership provides some level of security for both employees and the organization.

4. The need to establish the context for analysis and change.

Related to the previous point, and also a result of the experience in the development of the targeting process is the need to establish and understand the context of the situation. Researching the hospital environment showed that attempts to get some consensus continually floundered because of the lack of any clear context. QA personnel were focused on minor improvements to processes and in finding ways to make the patients happy. The nursing staff were concerned about reducing the amount of time on clerical duties and on having more time with patients. The administration was concerned with maintaining the reputation of the hospital. There did not appear to be alignment of purpose and objectives. There was no apparent clear purpose for creating change, no major objectives, and no real view as to where the revenues were coming from.

The steadfast position of the administration, management team, nurses and QA staff was that the patients were the customers, even though it was the government that was about to significantly cut the revenue stream. Arguments that the government was actually the customer, as they paid for the services, were rejected by the nurses, QA staff and the administration. In its efforts to introduce TQM, the patient had clearly been identified as the primary customer, and there was consensus on this.

The conclusion, in the light of all this, was that the context of the situation needed to be developed and established in some systematic way. The context had to clearly indicate what the purpose of the changes were, and what the performance requirements would be. The setting of the context would, hopefully, provide an indication at the start of the targeting process as to whether a win-win would even be possible. The experience at the hospital showed that this should be clarified at the beginning. If a win-win is not possible, there is no point in looking for one.

5. The need for senior management participation.

The hospital research illustrated a situation where management was unwilling and unable to develop alternatives and implement change. The management system in the hospital worked with very strong input and influence from the workers, which, in the crisis, led to the predictable problems associated with delegating authority to those who may be dis-advantaged by any changes. In contrast to the other two case studies, the exploratory nursing care case highlighted the fact that the whole process will bog down and no real results can be realized if management does not actively participate.

The Radiology case, in contrast, saw strong support and implementation of developed alternatives. The drilling fluids case began with the intent of arriving at major improvements. Rather than an acceptance of a trial of the process, this group actively desired a process to use to target major improvements.

6. The need to arrive at an alternative quickly.

In the drilling fluids case, time was essential to protect the security of the business. The radiology case illustrated that a speedy development and implementation of change could diminish or eliminate the effects of a pending crisis.

In both cases, the rapid development of alternatives was a requirement. When facing resistance, it is needed to objectively shift the focus of the organization. In cases where there is support, it prevents or eliminates the damage and enables a quick resolution of the existing crisis.

7. The need to prioritize based on revenues.

The work of Goldratt confirmed that prioritization needs to be based on revenue effects, and that changes cannot be developed properly without allowing for the effects they may have on the revenue stream. The important factor in a crisis is to improve the difference between revenues and costs.

8. The effectiveness of integrating QFD and Goldratt's Concepts.

A secondary conclusion arising from this is the effectiveness of integrating QFD and Golratt's concepts into a systematic prioritization process. The process was effective in focusing attention at the critical areas. It also was capable of providing diverse and unusual results which were confirmed as being appropriate.

7.6 Contribution

The research has added evidence of the need for top management to directly develop alternatives in time of crisis. The targets developed by management then can enable the shift from a win-lose situation to a win-win one where it may be possible for workers to participate in bettering the alternatives.

It has also been shown that there can be more difficulty in determining which areas are priority ones in service based organizations as compared to manufacturing organizations. The prioritization scheme developed in the research addresses this problem. In contrast with TQM, which may not be successful in handling a crisis, the targeting procedure utilizes tools adapted from TQM within a context of establishing priorities to extend the effective range of these tools.

Another significant deviation from conventional crisis management methods is the use of increased costs as a means of addressing the crisis. By using a revenue based focus, and considering the net difference between revenues and costs, it has been shown that increasing costs is useful if the revenues go up by a larger amount. It is the difference between revenues and costs which is important, not the level of costs.

Finally, the reduction of constraints on the development of system alternatives increases the amount of options which may be considered. This factor is closely related to the prioritization scheme which focuses on the effects on net revenues rather than costs. A cost focus immediately constrains the change process, whereas a net revenue focus is directly related to the nature of a crisis: financial pressure.

As developed, the targeting process differs significantly from conventional crisis management methods which quickly narrow the priority for and scope of analysis internally to cost and or production reduction techniques without regard to external factors or the complex internal interactions. The novelty of the targeting process lies in the inherent characteristics of being externally focused in systematically developing a quick convergence as to what is desired, where to look and reducing the constraints as to how to get a solution.

7.7 Areas for Further Study

There were several findings in the studies and analysis which indicated further study. It warrants further research as to whether management's attitude and philosophy is more directly linked to the issue of generating a win-win. This will have a significant impact on the notion of creating a "default" position. In the radiology and drilling fluids cases, a win-win potential was established with the context stage, and everyone participated in creating alternatives which were readily implemented. The default position was not needed, as a directly implemented alternative was developed.

Further study and research should be undertaken to validate the usefulness of the prioritization stage to find an extremely complex environment for application to the whole organization, including cascading to lower levels after initial priorities have been established and addressed. This application would further refine the prioritization stage for more general use, and identify where there may be possible enhancements or simplifying steps for more complex applications.

Application of the targeting process leads to some research questions in the area of project management. It may be that the integration of design with process management may provide design alternatives which might cost more to build, but provide the customer with lower total life cycle costs. The in field cost of procurement and construction will remain important, but designing the processes and system for maximum overall return is an area which warrants further research as a means for improved contractor competitiveness. In that light, a contractor may have to obtain greater process knowledge, rather than over the fence supply of process engineering.

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